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Variations with Depth of Oceanographic Properties Along the Equator in the Pacific

THOMAS S. AUSTIN

Abstract—The vertical distribution along the equator in the Pacific of temperature, salinity, density, oxygen, and phosphate, from the sea surface to 1000 meters, and the anomaly of the dynamic height of the sea surface and other isobaric surfaces above the 700-decibar surface are shown. In each of the figures, the available data have been partitioned according to the date of the observation into two periods, July to December and January to June, which are designated in the text as summer and winter, respectively. The figures include data from stations within one degree of latitude north or south of the equator between 110°W and 135°E longitude.

The surface of the sea, relative to the 700-db surface, slopes upward, east to west, approximately 0.8 dynamic meters; the value for the slope is 5.0×10^{-8} during both summer and winter. The longitudinal pressure gradient does not extend much below the layer of relatively large vertical density gradient. At the depth of $\sigma_t = 26.5$, 250–300 m, relatively little east-west slope is evident.

In the surface layer (sea surface to top of the thermocline), temperatures along the equator are lower in the eastern Pacific during both periods; the thermocline is comparatively level west of the 180th meridian, sloping upward to the east of this longitude. Temperatures are appreciably lower and concentrations of inorganic phosphate are higher in the surface layer in the eastern Pacific during the summer, both reflecting the temporal and longitudinal variations in divergence and upwelling.

The oxygen minimum, centered at a depth of approximately 450 m, is a continuous feature from 100°W longitude (eastern limit of the profiles) to near 170°E longitude, with the lowest concentrations in the east (≤ 0.5 ml/L) increasing to 1.5 to 2.0 at the westward limit. West of 170°E longitude, concentrations at 450 m rapidly increase to 3.0 ml/L.

In recent years, numerous profiles illustrating the vertical distribution of properties along meridional (north-south) sections crossing the equator in the Pacific have appeared in the literature. Data thus presented included, for examples, those from cruises of the *Carnegie* [*Sverdrup* and others, 1942], the *Hugh M. Smith* [*Austin*, 1954a; *Montgomery*, 1954; and *King* and others, 1957], the *Albatross* [*Jerlov*, 1956], and various Japanese research vessels [*Mao* and *Yoshida*, 1955]. These data, which were rather widely spaced with respect to both geography and time, were inadequate for consideration of seasonal variations in trans-Pacific vertical profiles, particularly along the equator.

During August through October 1956, 12 vessels participated in EQUAPAC, a quasi-synoptic oceanographic survey of the equatorial Pacific between approximately 20°N and 10°S latitude and 135°W to 135°E longitude. Data from EQUAPAC, plus those from previous and subsequent surveys, now make it possible to study in some detail the vertical distribution and seasonal variations of properties along the equator. In the accompanying figures, profiles for temperature, salinity, density (σ_t), oxygen, and inorganic phosphate, and the anomaly of the dynamic height of the sea surface and other isobaric surfaces above the 700-db surface are shown.

The stations selected for use in the figures were all located within one degree of latitude (60 nautical miles) north or south of the equator. Pertinent information for the stations, each of which has been designated by a letter-number combination on the figures, is listed in Table 1. Wherever available, interpolated data from each station were plotted at standard depths, otherwise observed data were used. In drawing the contours, an effort was made to suppress configurations which apparently resulted from station-to-station temporal variations. This was not always possible without violating plotted values and consequently localized irregularities appear in the isopleths. Some available data were not utilized because they appear to have been recorded during seasons or years which were atypical for their longitude. For example, at *Carnegie* Station 98 near 175°W, the temperatures from the surface to depths somewhat below the thermocline were considerably higher (+6° to +10°C at 200 m) than those for nearby stations, resulting in a pronounced trough in the isotherms.

TABLE 1 – *Pertinent data for oceanographic stations included in Figures 1–6*

Station[a]	Date	Latitude	Longitude	Reference
		° ′	° ′	
July to December				
Ka 613	Aug. 1, 1956	00 38 N	130 20 E	*Kagoshima University* [1957]
Ke 621	Aug. 2, 1956	01 00 N	135 08 E	*Kagoshima University* [1957]
Sa 32	Aug. 18, 1956	00 29 N	139 49 E	*Suda* [1957]
Sa 14	Aug. 5, 1956	00 30 N	151 02 E	*Suda* [1957]
Ho 31	Aug. 24, 1956	01 00 S	156 46 E	*Scripps Inst. Oceanogr.* [1957]
Ho 10	Aug. 13, 1956	00 02 S	163 57 E	*Scripps Inst. Oceanogr.* [1957]
Or 10	Oct. 4, 1956	00 12 S	170 03 E	Unpublished data; Institut Français d'Océánie
Or 12	Oct. 13, 1956	00 15 N	176 28 E	Unpublished data; Institut Français d'Océánie
Dai 21	July 13, 1956	00 10 N	179 57 W	*Shizuoka Pref. Fish. Exp. Sta.* [1957]
St 34	Sep. 15, 1956	00 01 N	174 59 W	*Scripps Inst. Oceanogr.* [1957]
Sm 23	July 10, 1950	01 00 S	171 57 W	*Cromwell* [1954]
St 21	Aug. 29–30, 1956	00 02 N	166 59 W	*Scripps Inst. Oceanogr.* [1957]
Sm 164	Sep. 27, 1956	00 01 S	159 52 W	*Austin* [1957]
Al 111	Nov. 15, 1947	00 02 N	152 07 W	*Bruneau* and others [1953]
Sm 32	Sep. 27, 1951	01 00 S	149 58 W	*Austin* [1954a]
Sm 113	Sep. 2, 1956	00 02 N	143 03 W	*Austin* [1957]
Sm 144	Nov. 20, 1955	00 16 N	140 11 W	*King* and others [1957]
Sm 62	Aug. 19, 1956	00 04 S	134 54 W	*Austin* [1957]
Sm 94	Nov. 7, 1955	00 11 S	119 58 W	*King* and others [1957]
Ba 23	Oct. 12, 1955	00 58 N	116 03 W	*Scripps Inst. Oceanogr.* [1956]
Sm 73	Oct. 31, 1955	00 12 S	112 25 W	*King* and others [1957]
Da 3558	Sep. 18, 1928	00 18 S	99 07 W	*Thomsen* [1937]
Ba 58	Nov. 28, 1955	00 00	91 41 W	*Scripps Inst. Oceanogr.* [1956]
Ba 51	Nov. 15, 1955	00 00	83 47 W	*Scripps Inst. Oceanogr.* [1956]
January to June				
Ja 97	June 14, 1938	00 49 N	149 54 E	Unpublished data, U.S.N. Hydrogr. Of.
Ja 101	June 17, 1938	00 48 N	153 49 E	Unpublished data, U.S.N. Hydrogr. Of.
Al 143	Jan. 3, 1948	00 09 S	163 23 E	*Bruneau* and others [1953]
Sm 25	Feb. 18, 1952	00 02 N	179 59 E	*Stroup* [1954]
Ca 98	Apr. 30, 1929	00 18 N	173 59 W	*Fleming* and others [1945]
Sm 40	Mar. 4, 1952	00 01 N	169 00 W	*Stroup* [1954]
Sm 35	Feb. 20, 1950	00 04 S	158 22 W	*Cromwell* [1951]
Sm 9	Jan. 31, 1952	00 06 S	155 14 W	*Stroup* [1954]
Sm 88	Mar. 20, 1957	00 01 N	145 02 W	*Wilson* and *Rinkel* [1957]
Sm 22	June 5, 1952	00 43 S	140 11 W	*Austin* [1954b]
Sm 43	Feb. 25, 1957	00 00	130 00 W	*Wilson* and *Rinkel* [1957]
Sm 3	Jan. 23, 1957	00 03 N	123 17 W	*Wilson* and *Rinkel* [1957]
Sm 6	Jan. 24, 1957	00 22 N	120 11 W	*Wilson* and *Rinkel* [1957]
Sm 12	Jan. 26, 1957	00 06 N	113 54 W	*Wilson* and *Rinkel* [1957]
Sm 15	Jan. 27, 1957	00 12 S	110 12 W	*Wilson* and *Rinkel* [1957]

[a] Al, *Albatross*; Ba, *Spencer F. Baird*; Ca, *Carnegie*; Da, *Dana*; Dai, *Daifuji Maru*; Ho, *Horizon*; Ja, Jap. 90029; Ka, *Kagoshima Maru*; Ke, *Keiten Maru*; Or, *Orsom III*; Sa, *Satsuma*; Sm, *Hugh M. Smith*; and St, *Stranger*.

There are two profiles for each of the fields depicted, one for the period July to December, the other for January to June. These two periods, for simplicity of terminology and discussion in the subsequent text, have been designated as 'summer' and 'winter,' respectively, without implication as to the summer and winter seasons recognized in higher latitudes. The division of the year into the two six-month periods resulted primarily from consideration of the seasonal variability in the trade winds and also from the necessity of selecting periods within which there would be a sufficient number of stations to provide adequate data for the sections. The southeast trades (of particular significance along the equator) are at maximum constancy and force in August–September, minimum in March–April.

Vertical profiles along the equator are of diversified interest. As expressed by *Montgomery* and *Palmén* [1940], the equator is the ideal location for determining the longitudinal pressure gradient. At the equator there can be no cross-stream gradient because deflecting force and compensating pressure gradient both vanish. Of interest to both the physical oceanographer and the marine biologist are the east-west (and seasonal) variations in the

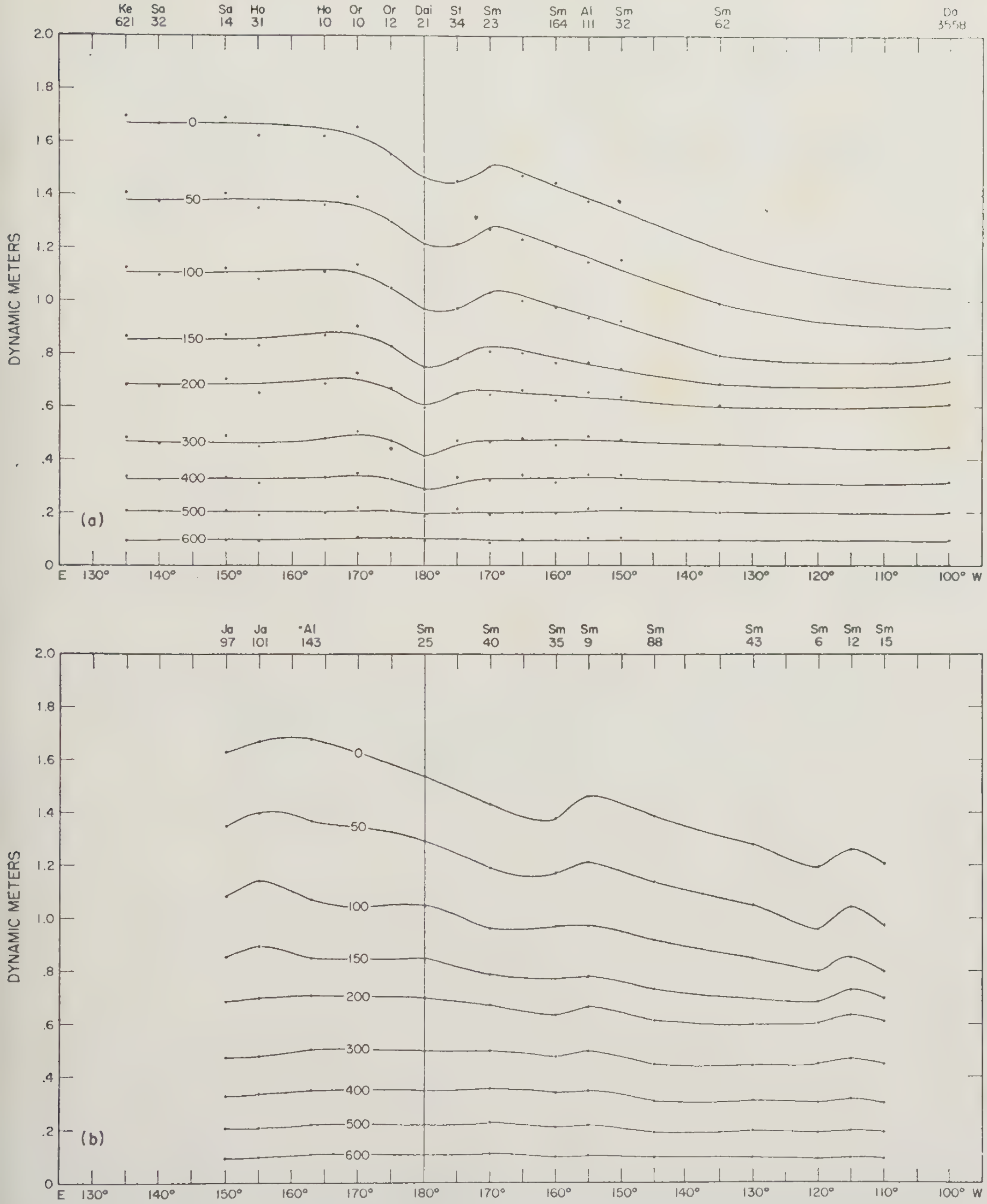

FIG. 1 – Anomaly of the dynamic height of the sea surface and other isobaric surfaces above the 700-db level; (a) July to December; (b) January to June; see Table 1 for position, date, and source of data for each station designated along the top borders

slope of the thermocline and of the equatorial divergence and upwelling.

In Figure 1 we have shown the anomaly of the dynamic heights for the sea surface and other isobaric surfaces, all relative to the 700-db assumed level of no motion. During both periods, the sea surface slopes upward, east to west, with a mean value for the slope of 5.0×10^{-8} (0.8 m in 15×10^3 km) during both the summer and the winter. *Montgomery* and *Palmén* [1940] calculated the slope to be 4.5×10^{-8}.

Between the two periods there are variations in

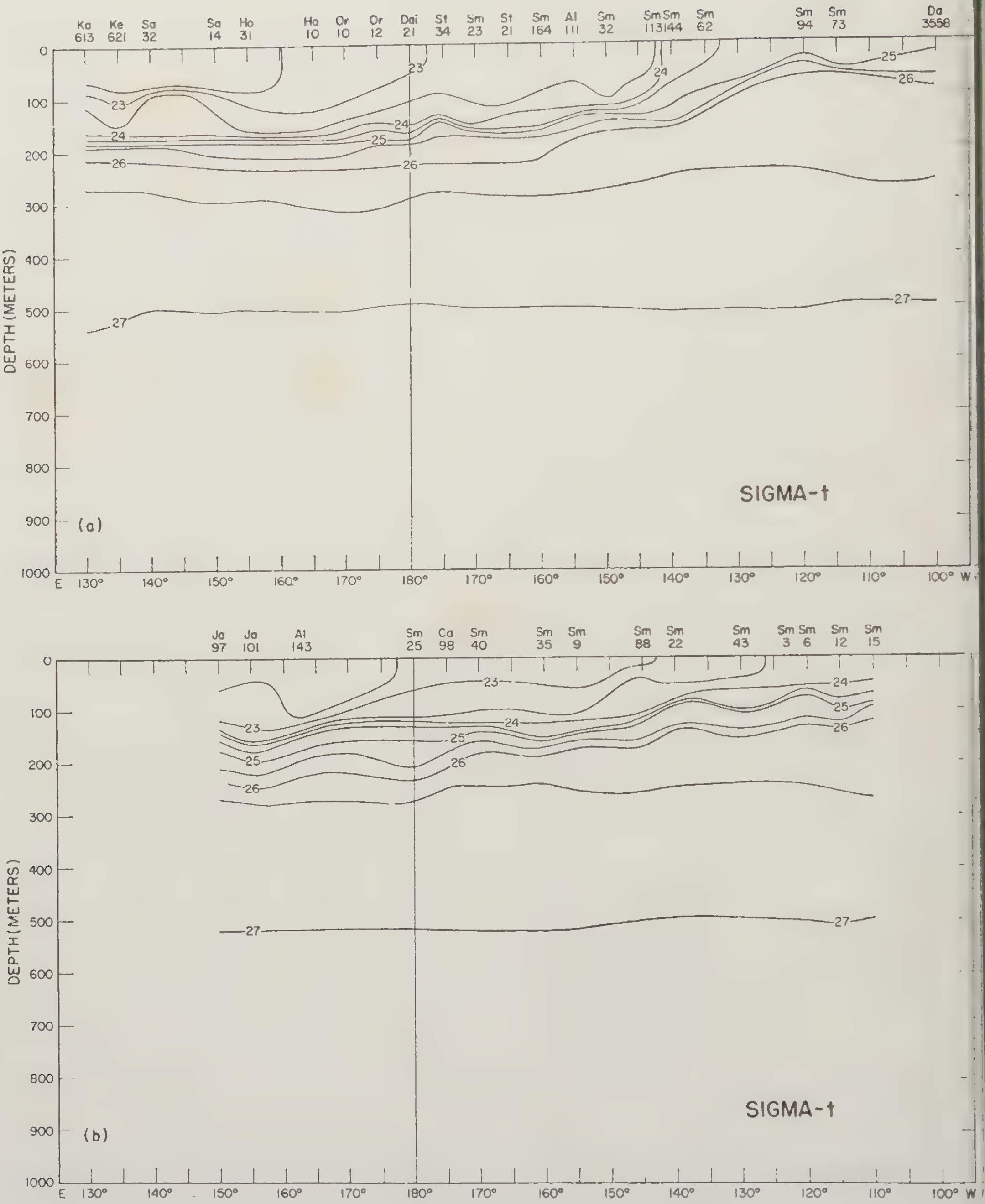

FIG. 2 – Density; contour interval 0.5 units of sigma-t; (a) July to December; (b) January to June

the height of the sea surface in the eastern Pacific. During the summer, east of approximately 165°W longitude, the surface is 10–15 dynamic centimeters lower (relative to the 700-db surface) than during the winter. The dips in the anomaly of the dynamic height of the sea surface near 180° in the summer and 165°W in the winter are difficult to explain. Enough stations are involved in each case to suggest that they are a real feature.

Montgomery and *Palmén* [1940, Fig. 43] demonstrate that the longitudinal pressure gradients in the Atlantic and the Pacific do not extend below the layer of relatively large vertical gradient in density (hereinafter referred to as the stable layer).

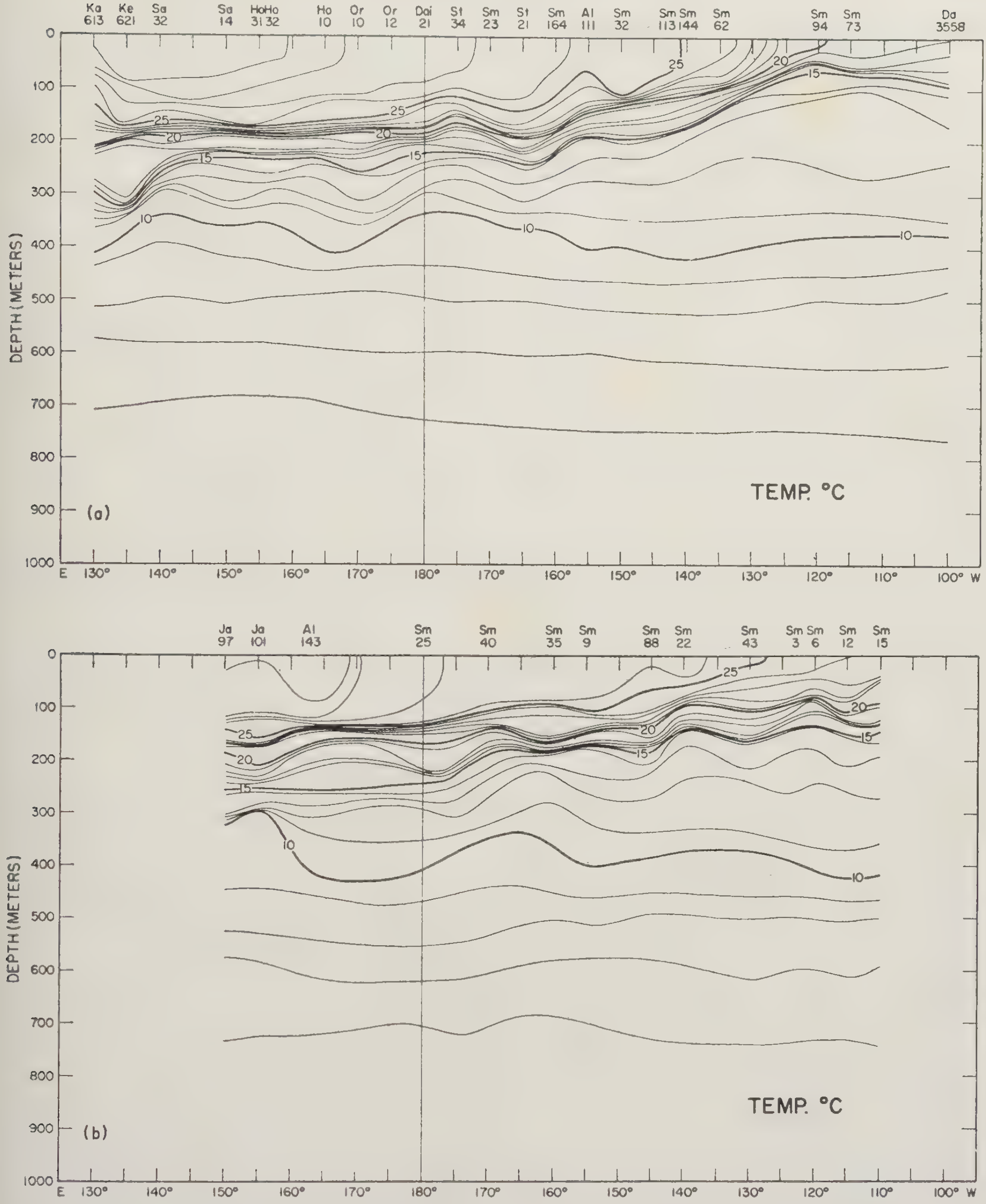

FIG. 3 – Temperature; contour interval 1°C; (a) July to December; (b) January to June

For their analyses of the situation in the Pacific, data for only two positions were available, one at 99°07′W, the other at 134°44′E longitude. Using the data from the stations included in Figure 1, the σ_t distribution along the equator is shown in Figure 2. Although, when comparing Figures 2a and 2b, variations in density are evident in the surface layer (surface of the sea to top of the stable layer) and in the east-west slope of the stable layer, the 26.5 isopleth (250–300 m) in both figures shows relatively little east-west slope.

During the summer, the east-west slope of the stable layer is steeper than in the winter east of 160°W; conversely to the west of 160°W, the slope

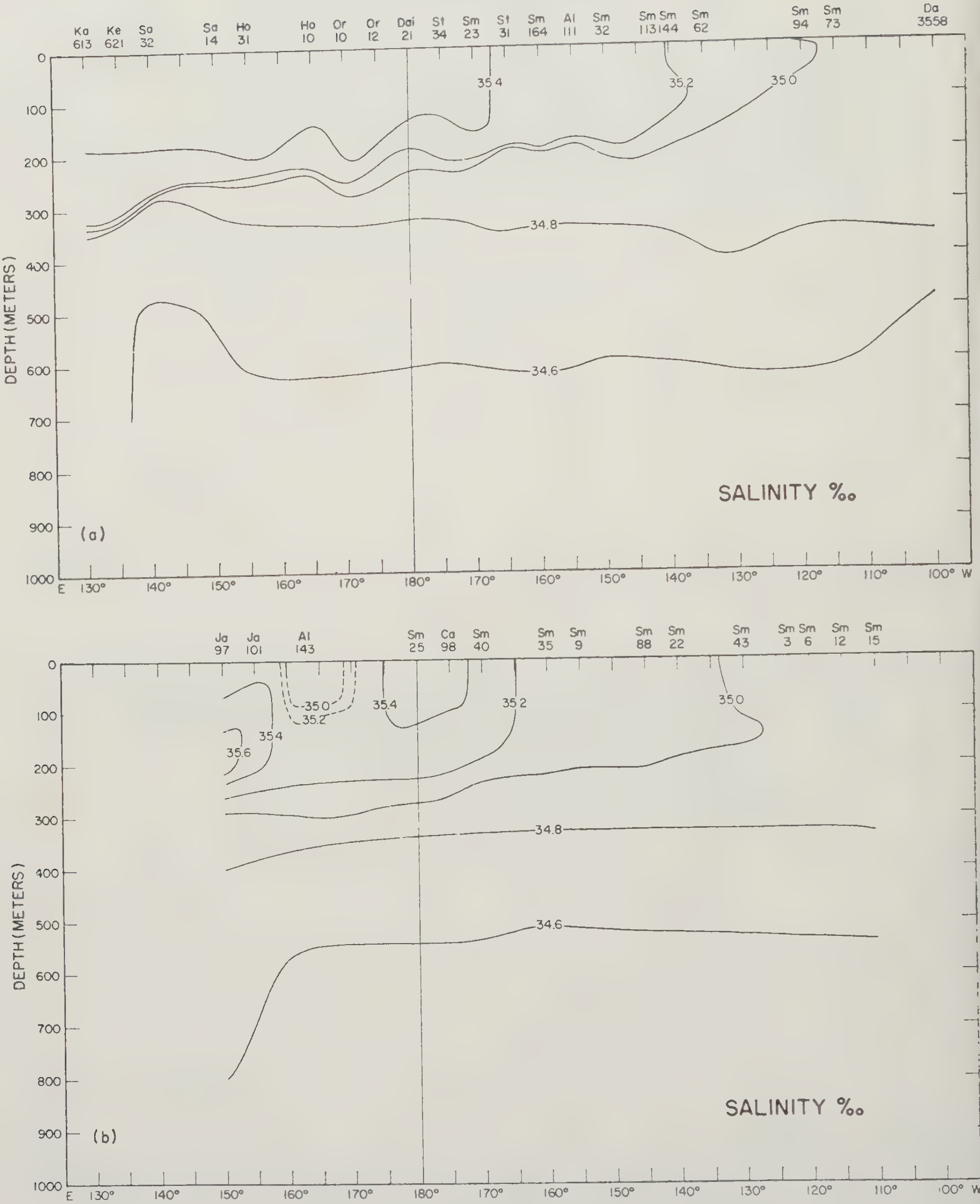

FIG. 4 – Salinity; contour interval 0.2 per mille; (a) July to December; (b) January to June

is less in summer than in winter. In terms of depth of the stable layer, in the west it is deeper and in the east shallower in summer than in winter. These variations, evident in Figure 2 (and 3), reflect the greater volume of lighter, warmer water in the western Pacific during the July to December period.

Variations in density and thus in the results of the geostrophic calculations in the tropical Pacific are principally a function of variations in temperature. The vertical distribution of temperature is shown in Figure 3. In general, the temperatures in the surface layer are cooler in the eastern Pacific than in the west; the thermocline is comparatively

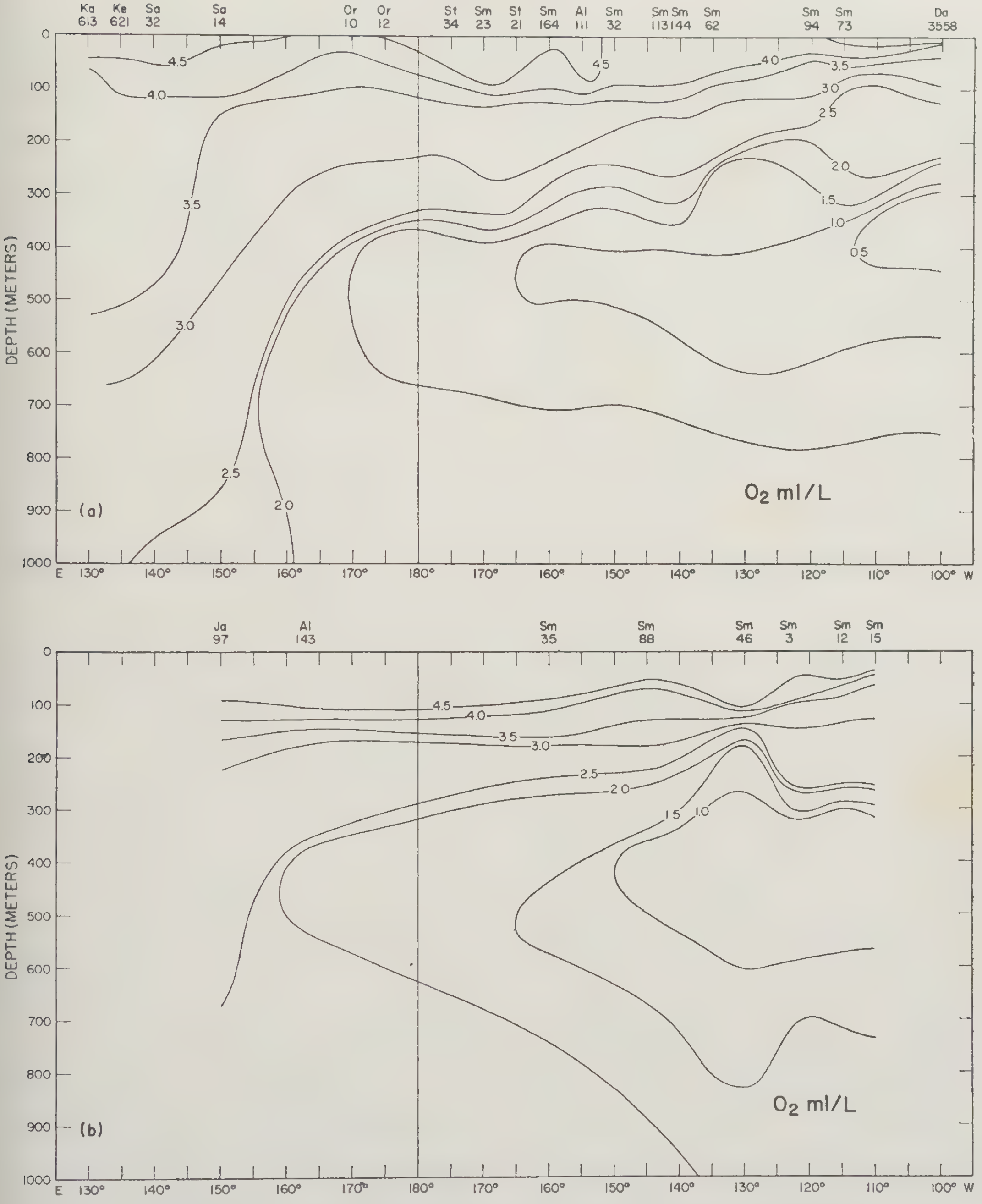

FIG. 5 – Oxygen; contour interval 0.5 milliliters per liter; (a) July to December; (b) January to June

level in the western Pacific, sloping upward east of the 180th meridian [*Sverdrup* and others, 1942, Fig. 197]. During the summer period, particularly in the eastern Pacific, the temperatures of the surface layer are considerably cooler than during the winter, while in the west, summer temperatures are warmer to greater depths.

Austin and *Rinkel* [1957], in part through a comparison of meridional temperature sections, have shown that there is an east-west variation in upwelling at or near the equator in the Pacific with the maximum mixing of the deeper, cooler waters with those at the surface being in the eastern central Pacific. In addition, they state

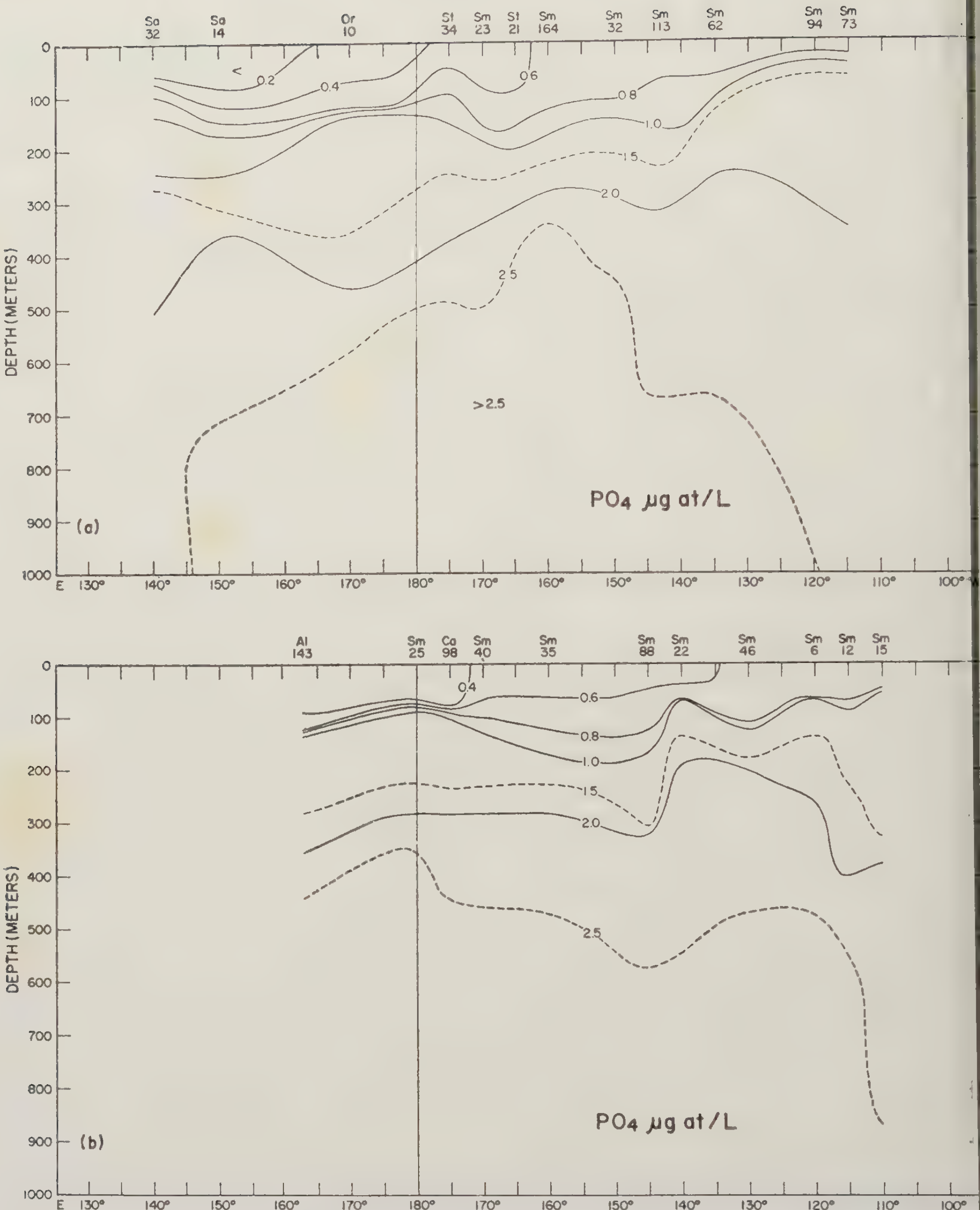

Fig. 6 – Inorganic phosphate; contour interval 0.2 for concentrations less than 1.0 microgram atoms per liter; 0. for concentrations greater than 1.0 microgram atoms per liter; (a) July to December; (b) January to June

that the period of most active upwelling is during August through October, the period of the maximum constancy and force of the easterly component of the southeast trade winds. These conclusions are reflected in the cooler surface waters in the eastern portion of Figure 3a.

The more active upwelling in the eastern Pacific during the summer is also reflected in the vertic distribution of salinity (Fig. 4). In the easter Pacific, the mixing processes associated wit upwelling limit the penetration of the waters of th intermediate salinity maximum into the norther hemisphere [*Austin*, 1954b; *Austin* and *Rinke* 1957]. In the western Pacific, these waters pen trate to 5° to 10°N [*Mao* and *Yoshida*, 1955]. In the eastern Pacific the effect of the mixing by upwelling of the higher salinity water of the maximum with the waters in the surface layer is more pronounced in the summer than in the winter (Fig. 4).

The most pronounced feature in the vertical distribution of oxygen, both summer and winter (Fig. 5), is the oxygen minimum centered at about 450 m beneath the sea surface. The lowest oxygen concentrations in the minimum are in the eastern Pacific (0.5 ml/L or less), increasing progressively westward to about 165°E where the minimum essentially terminates.

The waters at depths of the oxygen minimum (temperature about 9.0°C, salinity 34.70 $^0/_{00}$) are characterized by *Sverdrup* and others [1942, Fig. 196] as Equatorial Water which is probably formed off the coast of South America by gradual transformation of the Subantarctic Water and which spreads to the north and to the west. The oxygen minimum is shallower than the salinity minimum (1000 m, $T = 5.5°C$, $S = 34.50–34.58$ $^0/_{00}$) which Sverdrup denotes as the 'core' of the Antarctic Intermediate Water.

The concentrations of inorganic phosphate in the surface waters (Fig. 6) are comparatively higher in the eastern Pacific, 0.6–0.8 μg at/L as compared with ≤0.2 μg at/L in the western half of the ocean. In general, east of 160°W they are higher during July to December, the period of most intensive upwelling.

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SEASONAL VARIATIONS IN THE OCEANOGRAPHIC AND THE MARINE BIOLOGICAL FEATURES IN THE WATERS OF FRENCH OCEANIA (MARQUESAS)

The Pacific Oceanic Fishery Investigations (POFI) of the U. S. Fish and Wildlife Service is investigating the tuna resources of French Oceania, with particular emphasis in the waters near the Marquesas Islands. Two surveys have been conducted by POFI vessels, one during the Southern Hemisphere winter (August–October 1956) and one during the Southern Hemisphere summer (January–March 1957). During both surveys, the general oceanic circulation features, the productivity of the ocean waters, and the abundance of the tuna and their availability to longline and live-bait fishing methods were investigated.

Preliminary study of the oceanographic data reveals that the flow of water incident to the Marquesas–Tuamotu islands was from the southeast. In the general region of the islands, and down-current from the islands, there was evidence of large-scale, but weak, eddies. The westerly transport through a section near 145° W. longitude, between the surface and 500 meters, was $5.8 \times 10^7 m^3$ during the summer cruise, $4.5 \times 10^7 m^3$ during the winter cruise.

Although the summer-winter variations in the general circulation features were not striking, the seasonal variations in the concentration of inorganic phosphate and the indices of productivity at the lower trophic levels were very evident. During the Marquesan summer, the supply of inorganic phosphate in the surface waters, the rate of photosynthesis as measured by the uptake of C^{14}, and the zooplankton volumes were, in general, one-half the values observed during the Southern Hemisphere winter.

The surface tunas were apparently more abundant during the Marquesan summer. On two summer cruises, 104 tuna schools and associated bird flocks were observed in January and 97 schools in February, as compared with 42 schools sighted on a similar traverse in September during the Marquesan winter. The surface tuna bit at a slow rate, however. During the Marquesan summer, 99 schools were fished; 36 responded with a catch of one or more tuna and 12 with a catch of 100 or more from each school. During the winter, only one school of tuna was successfully fished. Ten were chummed. Using longlines, the catch rate of the deep-swimming tunas was 6.0 per 100 hooks during the summer, and 0.3 during the winter.

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ESTIMATING MAXIMUM FISHING DEPTH OF LONGLINE GEAR WITH CHEMICAL SOUNDING TUBES

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UNITED STATES DEPARTMENT OF THE INTERIOR
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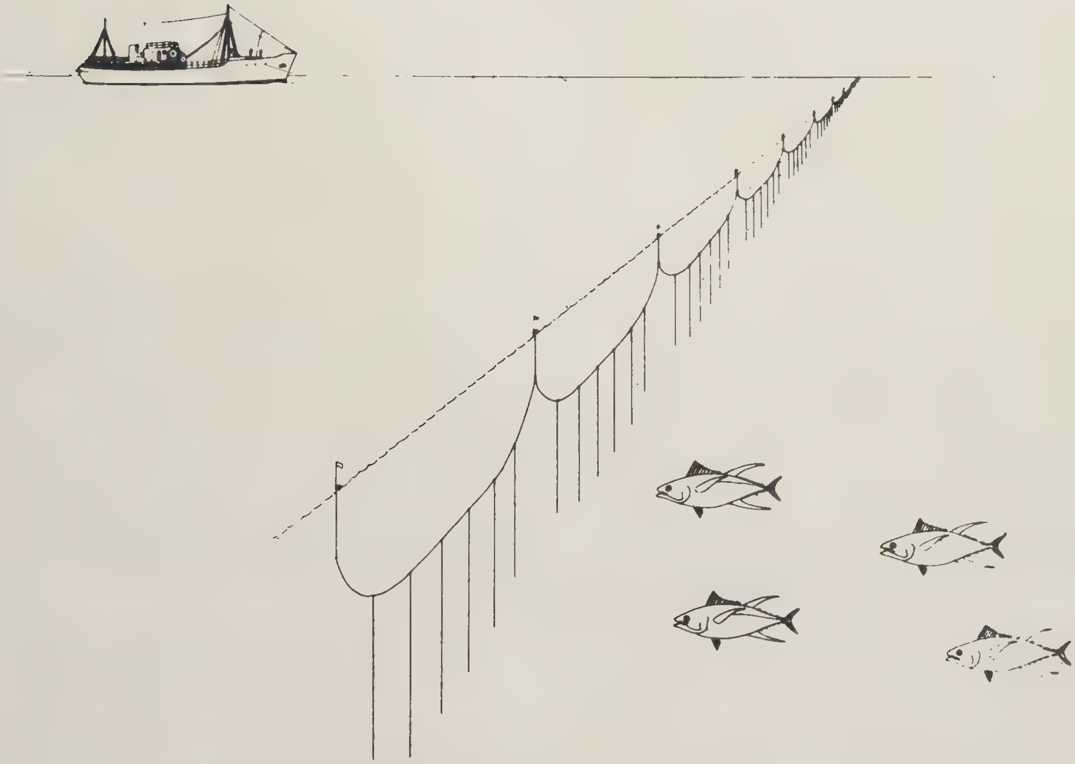

ESTIMATING MAXIMUM FISHING DEPTH OF LONGLINE GEAR WITH CHEMICAL SOUNDING TUBES

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ABSTRACT

A summary of methods used by various investigators to estimate the fishing depth of longline is given. Sounding tubes, used by POFI in conjunction with studies of albacore tuna, Germo alalunga (Bonnaterre), in the central North Pacific, measure the depth of the longline with considerable accuracy. A method, using readings provided by the tubes, is developed so that the observed "hang" of a given basket of gear and the theoretical "hang" can be compared. The results obtained suggest that the configuration of the mainline in the individual baskets does not conform to a catenary. We conclude that the skewness in the shape of the line did not occur during the fishing period, but rather during retrieving operations when slack formed in hauling allowed a portion of the gear to sink below the maximum fishing depth. It is suggested that distortions related to retrieving procedures can be overcome. A method is presented by which the maximum fishing depths for individual hooks along an entire set of gear can be estimated.

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Longline gear of the type employed in this study was developed by Japanese fishermen to capture fish swimming at considerable depths below the surface of the ocean (Shapiro 1950). During the past 5 years this gear has permitted an expansion of the Japanese high seas tuna fishery, particularly in the South Pacific and Indian Oceans. The longline has also been used with success by American fishery research organizations[2] to ascertain the abundance of oceanic tunas.

Attempts to determine the fishing depths of longline gear have been made by a number of investigators using various methods. Murphy and Shomura (1955) and associates made echo-sounding measurements of the depth of the deeper portions of the longline with a Bendix depth recorder. Bullis (1955) by use of the Echograph depth recorder obtained excellent traces of entire baskets of the mainline. Such measurements are difficult to obtain with consistency because of the large number of variables involved such as the state of the sea, the type of equipment, experience of the operator, condition of the equipment, tuning, etc. Murphy and Shomura (1955) also determined distances between buoys with the use of radar. A comparison of theoretical depths, derived from the buoy distances, with those obtained simultaneously with the Bendix, showed a low correlation; the Bendix readings being shallower than the theoretical. The authors suggest that this low correlation was caused by the lack of precision in measuring line depth and buoy intervals, and also by the influence of environmental factors such as currents which might have caused shearing and thereby shoaling of the gear. Previous findings (Murphy and Shomura 1953), secured by use of pressure gauges attached to the deeper hooks of the longline, showed that the gear was most likely limited in its penetration of the thermocline, which was probably the boundary between the moving surface water and the stable deeper water, at least in the equatorial region. The use of pressure gauges was abandoned by Murphy and Shomura because of troublesome technical difficulties inherent in the mechanism.

Yoshihara (1954) gave the problem a completely theoretical treatment by deriving depths of individual hooks through a mathematical analysis. His analysis, though exacting, was based on assumptions that certain conditions were stable; i.e., that buoy distances were uniform throughout a set of gear and that the action of currents and winds upon the gear did not vary.

Finally, chemical sounding tubes, which give a measure of maximum fishing depth, have been used by various research agencies and investigators (Anonymous 1940, Yoshihara 1954, Anonymous 1955, Shomura and Otsu 1956, Iversen and Yoshida 1957). The discussion which follows is based on the results obtained by the use of chemical sounding tubes by Pacific Oceanic Fishery Investigations (POFI) in conjunction with studies of the albacore tuna, Germo alalunga (Bonnaterre), in the central North Pacific Ocean. We found that the sounding tube recorded the maximum depth of the longline accurately and showed that the unit or basket of gear was skewed from a catenary. However, the skewness was not related to the environment wherein the basket is thought to hang as a catenary, but it is suggested that readings in excess of fishing depth occurred during hauling. This difficulty is not insurmountable and a simple method is presented whereby the sounding tube may be fully utilized on longline. It is given to stimulate the study of the vertical distribution of tuna.

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[2] The California Department of Fish and and Game and the following Bureau of Commercial Fisheries organizations: Branch of Exploratory Fishing and Gear Research, Division of Industrial Research and Services, Pascagoula, Miss., and Portland, Maine, and the Pacific Oceanic Fishery Investigations, Honolulu, T. H.

We are indebted to Herbert J. Mann (POFI) for his counsel on gear operations, and to the captains, crews, and scientific personnel of the Hugh M. Smith, John R. Manning, and Charles H. Gilbert for their excellent cooperation. We especially wish to thank Richard S. Shomura and Tamio Otsu of the scientific staff for their special efforts in the field.

THE SOUNDING TUBE

The chemical sounding tube, developed in conjunction with a sounding machine by Lord Kelvin (Sir William Thompson) to take soundings while underway, has a long history in oceanographic work (Knight 1945). The glass tube, coated on the inside with a water-soluble chemical, measures 640 mm. in length and 4 mm. in outside diameter and is a relatively simple and inexpensive[3] depth indicator. Its operation is based on the relation between pressure and depth in a column of water. When the tube, open at the bottom and closed at the top, is lowered beneath the surface, water is forced into the open end of the tube. The chemical coating on the inside of the tube is dissolved, thus leaving a line of demarcation at the level reached by the water. From this record of pressure, the depth to which the tube was lowered may be read directly from a calibration scale.

Figure 1 shows the essentials of sounding tube gear used in conjunction with POFI's longline fishing. When the tube is prepared for use it is broken at the scored lower end and then inserted in the brass casing. Small sections of rubber tubing are threaded upon the protruding ends of the tube to retain it in the casing. The casing is then strapped to the longline dropper with plastic tape. Upon retrieving the gear the tube is removed from the casing and placed in the slot of the calibration scale. The depth in fathoms, indicated by the demarcation line in the tube, is read from the scale.

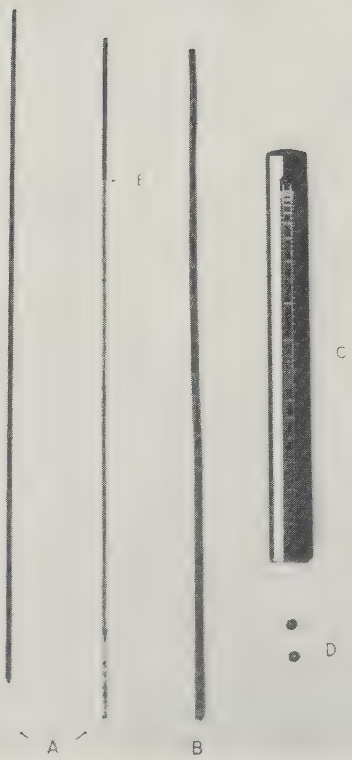

Figure 1.--Essentials of the sounding tube gear: (A) Glass sounding tube, (B) brass casing, (C) wooden calibration scale, (D) rubber hose. The tube on the reader's right has been submerged and shows a demarcation line (E).

Tests performed in the laboratory and in the field indicate that the sounding tube measures depth with considerable accuracy. Figure 2 shows regression lines calculated from laboratory and field data as compared with a theoretical line having a slope of 1. To obtain the laboratory data, 30 tubes were taken from POFI's stock, which represented portions of numerous orders. These were then divided into 6 lots, each of 5 tubes. By means of a pressure tank employed by the U. S. Navy to calibrate bathythermographs, pressures equivalent to depths of 100, 200, 300, 400, 500, and 550 feet were applied to the tubes. One lot of tubes was subjected to each depth equivalent. The resulting measurements of depth were read by three examiners. The difference between examiners was found to be statistically significant ($F = 3.40$, $P_{.05} = 3.11$), but was operationally small; the readings of the individuals did not differ more than 5 percent at any of the testing depths. It is difficult to evaluate this test in regard to field conditions since two of the examiners read the tubes one day following

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[3] Sounding tubes may be purchased commercially for $0.36 each and calibration scales for $1.75 each.

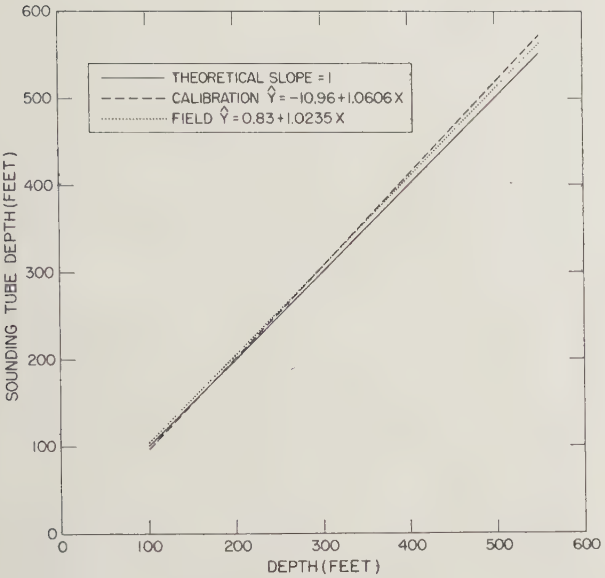

Figure 2.--Regression lines calculated from laboratory and field sounding tube data compared with a theoretical line having a slope of 1. Sounding tube depths are plotted along the y-axis. The x-axis represents depths recorded by bathythermographs and the calibration tank at Pearl Harbor.

the experiment while the author made his observations as the tubes were removed from the calibration tank. Also, one examiner had not read any tubes during the previous 2 years. However, the significant difference would suggest that special precautions should be taken to standardize readings of different observers in the field.

The regression line for the field data was calculated from observations obtained by Shomura and Otsu (1956) using bathythermographs as standards. Their data represent actual field conditions in that the sounding tubes were attached to bathythermographs and suspended with longline gear on fishing stations for the usual period of 5 to 6 hours. They found that their data varied about the theoretical line within the range of error of reading both the sounding tubes and the bathythermographs. The California Department of Fish and Game has also compared sounding tube measurements with those of bathythermographs and found tube readings to vary within 2 fathoms of bathythermograph readings (Anonymous 1955). The calibration line also agrees well with the theoretical line. Differences between the two lines are surprisingly small with variations ranging from 5 percent at 100 feet to no difference at 200 feet and to 4 percent at 500 feet.

APPLICATION TO LONGLINE GEAR

Eight albacore longline cruises have been made by POFI in the central North Pacific Ocean (Shomura and Otsu 1956, Graham 1957). Either 40 or 60 baskets of 13-hook gear (fig. 3) were set per longline station with 5- and 15-fathom floatlines alternated in groups of 5 to 10 baskets. During 5 of the 8 cruises, extra baskets with appropriate floatlines and with sounding tubes attached, generally on droppers 4, 7, and 10, were placed in each set. Hooks were omitted from the droppers of these baskets to prevent excessively deep readings due to the diving of captured fish and to preclude the danger from bare hooks during setting of the gear. It was felt that catches on adjacent baskets generally would not be able to submerge the relatively large buoys or floats (1' in diameter, 2' in length) used by POFI. Thus, these bore hooks and were baited. Such placement of the tubes afforded an opportunity to examine the conformation of the mainline in a representative number of baskets of longline gear.

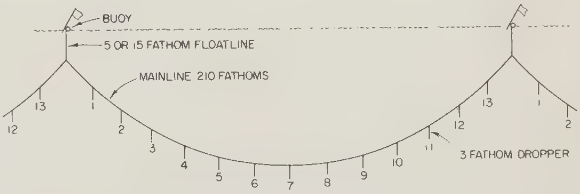

Figure 3.--A diagram of a basket of 13-hook albacore gear used by POFI in the central North Pacific. Leaders, 1-1/2 fathoms in length, are omitted from the above diagram. For a more detailed discussion of the gear consult Mann (1955).

In an ideal situation where, with the exception of gravity, no environmental forces are acting, the configuration of a basket of longline should be that of a catenary, exemplified by a chain hanging freely between two points of support. If it were found that such a gear approached a catenary under fishing conditions (Morita et al. 1955), then a simple method could be devised that would derive the maximum fishing depths of all the hooks on a given basket from a single sounding tube reading.

A scale model was constructed to determine whether the configuration of a basket of gear generally was that of a catenary. An area 25 inches in length and 12 inches in depth was marked off on graph paper having 10 divisions to the inch. Horizontally, the graph was scaled in feet (1 inch = 50 feet) to a portion of the mainline equivalent to a single basket of gear and vertically, from the maximum depth reading (600 feet) of the sounding tube scale (fig. 4). The graph paper backed by plywood was placed vertically against a wall. A unit of mainline was modeled from a silver chain (approximately 14 links to an inch and 1/8 inch in diameter) and the position of each hook marked; the droppers were omitted. With the omission of the droppers in the model, it was necessary to bring the tube readings up to the mainline depth. Therefore, all observed depths were adjusted by subtracting 9 feet, because sounding tubes were usually attached near the center of the 18-foot dropper. A pin, inserted through the link representing hook 7, was driven into the center of the graph at the observed depth for hook 7. The ends of the chain were brought up to and pinned at a depth representing the bottom of the floatline with hooks 4 and 10 of the chain passing through the observed depths obtained for those hooks. By removing the pin holding hook 7 and allowing the chain to swing freely to form a catenary, theoretical values for the 13 hooks could be determined. In this way the model permitted a comparison of the actual configuration of the mainline in the water, as shown by the tubes under fishing conditions, with that of a catenary having the same distance between its supports or buoys. Two very important considerations were thus taken into account by the method: one, that environmental forces may not act uniformly throughout the depth of the basket, and two, the distance between supports governs the configuration of the catenary.

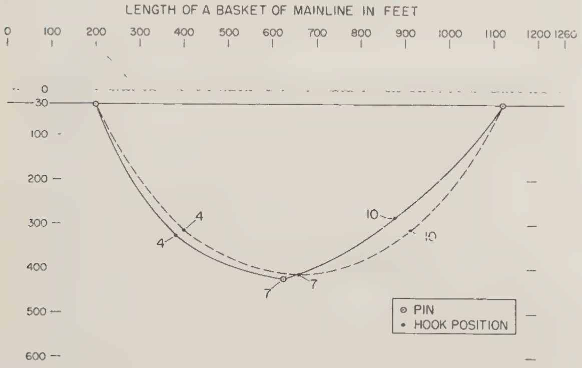

Figure 4.--The scale model, of silver chain, representing the mainline of a basket of longline gear. The method of using the model is explained in the text.

To ascertain whether the baskets of longline gear hung in a catenary, the observed (sounding tube) and theoretical values for hooks 4, 7, and 10 were paired and subjected to the "t" test. Depths, which were obtained from baskets skewed to the extent that either the chain would not reach, or it overshot the buoy line on one side or the other, were omitted from the statistical analysis since theoretical values could not be obtained. (These represented roughly 8 percent of the total number of baskets, which had sounding tube readings at all three hook positions.) A significant difference between any of the paired values would indicate that the baskets did not generally hang in the form of a catenary and the sign of the mean for each hook would suggest the direction that the basket deviated or skewed from the catenary. Table 1 summarizes the results of the "t" test and suggests that generally the baskets did not hang in a catenary. Hooks 7 and 10 show significant differences at the 1-percent level. The significance detected in hook 10 and the negative aspect of its mean difference are a reflection of the positive deviations observed in hook 4. This is illustrated in figure 4 where plots of a 5-fathom floatline basket show that a positive difference (observed > theoretical) in hook 4 is reflected by a negative difference

Table 1.--Summary of statistics for comparison of the mean differences (observed minus theoretical depth values). Lower comparison was carried out with values adjusted to the theoretical slope (fig. 2). Those "t" values attaining the 5-percent level and the 1-percent level of significance are noted by 1 and 2 asterisks respectively.

Hook number	Number of baskets	Mean difference (feet)	Standard deviation (feet)	"t" value
4	99	0.77	14.94	0.51
7	99	-7.03	20.06	3.48**
10	99	-4.75	15.73	3.01**
4	101[1]	1.99	15.32	1.31
7	101	-4.00	17.46	2.30*
10	101	-4.34	17.90	2.44*

[1] Two additional baskets, which previously did not reach or else overshot the floatline, were added to the analysis when adjustments to the theoretical depth were made.

(observed < theoretical) in hook 10 that is twice as large.

In a case where the gear is skewed toward one side, one would expect hook 7 to have a negative mean difference and a standard deviation somewhat smaller than hook 10. Because this is not so (table 1) it is likely that the error with depth shown by the sounding tubes in figure 2 must be unduly influencing the analysis. The data presented in the lower half of table 1 were obtained after an adjustment to the theoretical slope was made. The results were those anticipated; accompanied by a reduction of significance to the 5-percent level.

CAUSES OF SKEWNESS AND EXCESSIVE READINGS

The results show that generally the conformation of baskets of longline fished by POFI was not a catenary. It is thought that the sounding tubes were accurately recording the depths of the gear. Therefore, the cause of skewness noted in the baskets must be related to the environment or operative procedures. The relatively moderate environmental conditions encountered on longline stations during all seasons of the year suggest the latter was responsible (table 2).

However, a more detailed analysis of environmental factors was obtained by determining a measure of skewness, or the difference in feet between the depths of hooks 4 and 10 of the hookless baskets. In order that each set be comparable, only the hookless basket placed between baskets 25 and 26 or close to that position[4] was used in the analysis. Omitted from analysis were data from each hookless basket whenever, on the model, the mainline did not reach, or it overshot the buoy line. Skewness was then compared with a measure of current velocity (the mean longline drift), with possible decrease in current speed at the thermocline resulting in a shearing effect (the ratio of the depth of hook 7 of the hookless basket to the depth of the top of the thermocline)

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[4] In Hugh M. Smith cruise 29 and Charles H. Gilbert cruise 23 the hookless basket was placed at times between 24 and 25 or 26 and 27.

Table 2.--The average and range of certain physical conditions of longline stations during albacore fishing cruises in the central North Pacific

Cruise	Period	Total stations	Sea[1]		Winds, knots		Mean longline drifts, knots
			Mean	Range	Mean	Range	
Manning-19	1/15-3/11/54	16	3.1	1-6	11.4	2-24	0.09
Manning-22	9/13-11/9/54	16	3.1	1-5	17.1	4-35	0.12[2]
Manning-23	12/1-12/21/54	18	3.2	1-5	15.4	5-24	0.29[3]
Manning-25	5/2-6/9/55	18	2.2	1-4	8.5	3-14	0.42
Manning-26	7/15-9/7/55	38	2.7	1-5	11.1	1-24	0.30
Smith-29	5/2-6/22/55	30	2.7	2-4	15.9	6-30	0.44
Gilbert-23	9/15-11/2/55	8	2.4	1-4.5	15.1	10-28.5	0.36
Gilbert-27	3/15-5/4/56	7	2.7	2-4	13.6	8-19	0.24

[1] Coded; for values in feet see Hydrographic Office Observers' Manual, U. S. Navy Hydrographic Office, H. O. Pub. No. 606-c, 1951.

[2] This mean was computed with the omission of station 28 because the drift was undetermined.

[3] This mean was computed with the omission of stations 13 and 17 because the drifts were undetermined.

and with wind speed[5]. The three comparisons yielded low, non-significant correlation values suggesting that these effects individually were not related to the skewness observed in the baskets (r = 0.039, r = -0.055, and r = 0.055 respectively).

On the other hand, certain events in retrieving the gear, which could not be evaluated statistically, appeared closely associated with skewness of the baskets. Figure 5 shows three general directions at which longline gear was hauled aboard the POFI vessels: (1) Off the bow with the vessel's speed equalling the speed at which the line is brought in; (2) off midships with the speed of retrieving somewhat slower than that of the vessel; and (3) with the line astern and coming in much slower than the speed of the vessel. Differences in position between number 1 and 2 probably do not have any important effects on sounding tube measurements since the line is retrieved while at or above the maximum fishing depth. But, between 2 and 3, we believe that the vessel actually closes up the buoys of a basket and allows the mainline to sink. Since part of the line would be under tension from the line hauler only a portion would sink; which portion would depend on many conditions such as the speed of the line hauler, the distance between the "lay" of the longline and the parallel course of the vessel, etc.

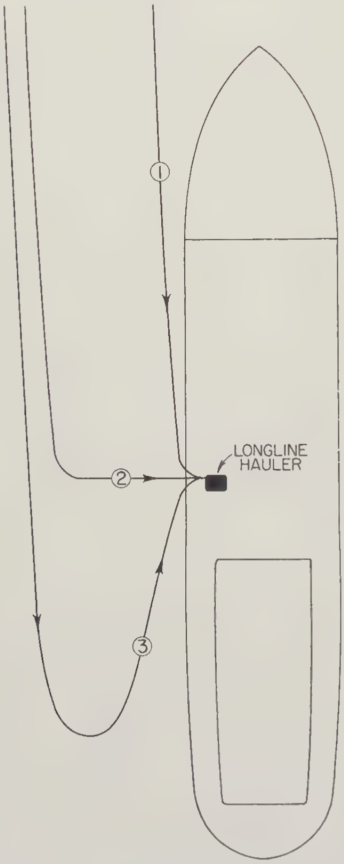

Figure 5.--Three general positions at which longline gear is retrieved: (1) Off the bow; (2) abeam; and (3) astern.

In addition to the effects on the line by the normal hauling procedure, disrupted retrieving could be responsible for obtaining sounding tube readings exceeding the depth at which the longline actually fished. On some longline stations, sounding tubes were attached on hook 7 position (hooks were omitted) at intervals along the set. In a few cases a sufficient number of tubes were attached to allow an examination of the "lay" of the entire mainline. Figure 6 shows the unadjusted depth distribution of hook 7 on baskets of four longline stations. Each station or set was made up of 40 baskets of longline with one hookless basket (unnumbered in fig. 6) inserted between baskets 25 and 26. Stations 17 and 18 of the Manning cruise 25 were occupied on consecutive days, as were stations 32 and 33 of the Gilbert cruise 27.

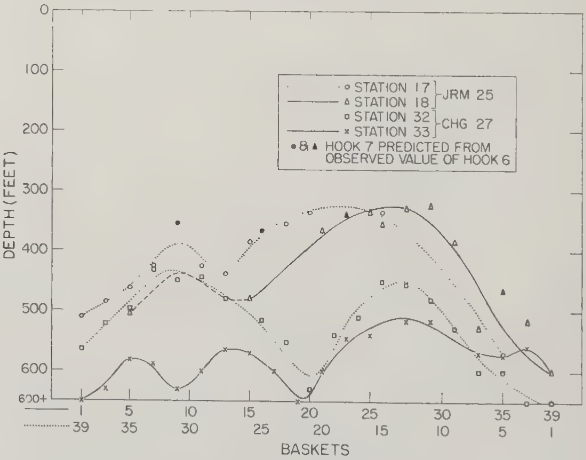

Figure 6.--Depth distribution of hook 7 on baskets of longline at stations 17 (31°36'N., 165°16'W.) and 18 (33°40'N., 165°32'W.) of the John R. Manning cruise 25, and 32 (34°31'N., 162°50'W.) and 33 (32°16'N., 163°04'W.) of the Charles H. Gilbert cruise 27.

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[5] Wind direction was ignored. It is a general practice on POFI vessels to set longline gear downwind and the vessel captains were reasonably successful in doing so. Of 98 sets made, 80 percent were with, to abeam of the wind and only 20 percent against, to abeam of the wind.

Five-fathom floatline gear was set first on station 17 whereas 15-fathom gear was set first on station 18; a like sequence was followed on stations 32 and 33. Thus, to compare similar gear types along the sets, stations 18 and 33 were plotted in the reverse of stations 17 and 32. The paired stations show considerable consistency and, with the exception of station 33, probably are fairly accurate descriptions of the "lay" of the gear in the water. The ends and center of the sets were deep and separated by two plateaus. This configuration is undoubtedly related to the alternation of a 5-fathom and 15-fathom floatline gear in groups of 10 baskets. Station 33 shows an additional trough and, in general, is considerably deeper throughout than station 32.

Line hauler trouble developed at basket 21 of this set and continued throughout the retrieving to the extent that parts of the gear were hauled by hand. Possibly the line was retrieved primarily from astern and the gear allowed to sink below the maximum fishing depth; or the hauling was so slow as to permit an effect similar to creating another end in the set. Figure 6 shows that the ends of the sets sank deeper than the center. Presumably this occurred because at the center a basket of gear has more or less equal tension applied on either side. However, toward the end of the set there are less baskets and thus less tension on one side of an individual basket than the other. This allows the buoys of the baskets near the ends of the set to close in toward the center dropping their mainline to depths greater than that of the same floatline gear in the center of the set. Operations with POFI longline gear in the equatorial Pacific show that an interruption of 30 minutes during hauling, at which time the gear is freed from the vessel, is sufficient to allow the newly formed end to register depths considerably greater than those shown by tubes on the gear hauled just before the break. When mainline breaks occur the new end formed must be retrieved rapidly to avert a deepening of the gear. Usually, the new ends caused by breaks were retrieved within 5 to 20 minutes during POFI albacore cruises.

Mechanical troubles are not alone responsible for such discrepancies because retrieving of the gear is sometimes delayed for varying periods of time during stormy weather and for the removal of large numbers of fish. Large fish may sound when captured on the longline and could increase the readings of sounding tubes if they were attached to the same dropper as the fish. The effect of the capture of a large number of tuna on longline gear was described by Bullis (1955, fig. 15b). He shows Echograph depth records of 10 baskets of longline in which 9 of the baskets approximated complete catenaries. The fifth basket was distorted with only a portion of the basket being recorded. This basket contained one yellowfin and four "blackfin tuna" while the others had no catch. It is noteworthy that the capture of fish on this one basket did not affect the adjoining baskets.

CONCLUSIONS

It is concluded that the maximum fishing depths of POFI longline, during albacore survey cruises, were recorded by sounding tubes with sufficient accuracy to locate the general depths at which the various sets of gear fished. They also showed the configuration of the baskets to deviate from a catenary. This deviation is thought not to have occurred during the fishing period but rather during retrieving operations when slack formed in hauling allowed a portion of the gear to sink below the maximum fishing depth. Also, deepening of gear below the maximum fishing depth presumably occurred when operational breakdowns or requirements formed a new end to a set. The above analysis is relatively simple and it cannot be ascertained whether the results obtained would be applicable to the longline operations of others. But, possibly most of the error in the catenary could be avoided merely by placing two tubes on a basket of gear on a pair of the shallower hooks, such as 3 and 11 in albacore gear, and accepting only the shoalest reading of the two. In this case, the estimation of individual hook depths from sounding tube readings might be reliable in areas where the physical environment did not distort the "hang" of a basket of gear.

Figure 7 shows the ideal relation of hook depths to the distance between buoys for hooks number 2 and 12, 4 and 10, and 7 without droppers and with 5- and 15-fathom floatlines. The curves were determined empirically using the scaled chain and plotting board described above (fig. 4). With these curves it would be possible to derive theoretical buoy distances from a given sounding tube reading for the above hooks. The scale model of a longline basket could then be pinned at the appropriate buoy interval on the plotting board and the theoretical depths for all hooks of that basket estimated. Reasonable extrapolation between baskets bearing sounding tubes would permit estimation of hook depths for an entire set of longline gear.

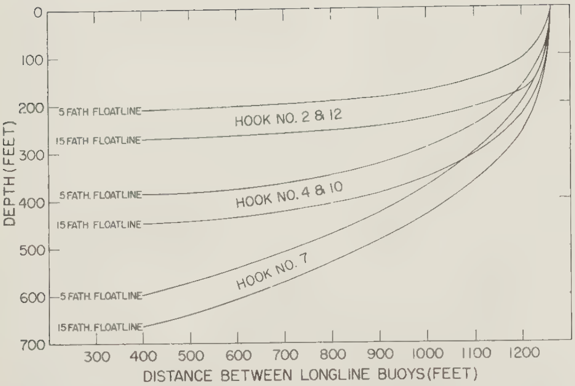

Figure 7.--The theoretical relation of the distance between buoys to the depths of various hooks on a basket of albacore longline. Droppers have been omitted.

SUMMARY

1. A brief summary of methods used to estimate the fishing depth of longline by various investigators is given.

2. Comparisons of field data with laboratory tests show that sounding tubes measure depth of longline gear in the field with considerable accuracy.

3. A method used to plot the observed "hang" of a given basket of gear and the theoretical "hang" is described. The results obtained suggest that the configuration of the mainline in the individual baskets does not conform to a catenary. We conclude that the skewness in the shape of the line did not occur during the fishing period, but rather during retrieving operations when slack formed in hauling allowed a portion of the gear to sink below the maximum fishing depth. It is suggested this may be averted by placing sounding tubes on a pair of the shallower hooks in a basket of gear and accepting the shoalest reading of the two.

4. It is suggested that in areas where the environment, such as currents and winds, does not distort the "hang" of a basket of longline, maximum fishing depths for individual hooks along an entire set can be estimated. An applicable method is given.

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APPENDIX

Table 3.--Analysis of variance to determine whether observers read sounding tubes with the same degree of accuracy

Source	Degrees of freedom	Sum of squares	Mean square	F	$P_{.05}$
Total	89	2,574,995.90	-	-	-
Depths	5	2,573,391.52	514,678.30	-	-
Examiners	2	122.71	61.35	0.68	1.97
Interaction	10	128.74	12.87	-	-
Individuals	72	1,352.93	18.79	-	-
Interaction not significant, so variance pooled:					
Examiners	2	122.71	61.35	3.40*	3.11
Individuals	82	1,481.67	18.07		

* Difference between examiners significant at .05 level.

Table 4.--Observed (sounding tube) and theoretical (computed) hook depths for cruise 23 of the Charles H. Gilbert

Station	Hookless gear between baskets	Float-line gear (fm.)	Hooks Observed depth (feet)			Hooks Theoretical depth (feet)			Computed buoy distance (feet)
			4	7	10	4	7	10	
16	6- 7	5	-	342	282	-	-	-	-
	16-17	15	324	408	294	320	388	320	1,060
	26-27	5	246	312	264	255	320	255	1,072
	36-37	15	342	414	348	344	422	344	1,008
17	5- 6	5	-	504	312	-	-	-	-
	15-16	15	264	354	312	295	352	295	1,107
	25-26	5	216	324	312	279	353	279	1,024
	35-36	15	384	384	294	350	431	350	993
18	5- 6	15	372	468	390	380	482	380	899
	15-16	5	258	348	288	278	350	278	1,028
	25-26	15	366	504	366	375	475	375	915
	35-36	5	300	402	312	308	400	308	944
19	5- 6	15	354	438	354	354	438	354	984
	15-16	5	282	354	276	278	353	278	1,026
	25-26	15	354	444	378	365	455	365	950
	35-36	5	294	390	306	300	387	300	971
20	5- 6	5	330	420	342	333	446	333	950
	15-16	15	324	414	324	330	400	330	1,043
	25-26	5	240	312	240	245	305	245	1,093
	35-36	15	354	480	378	363	452	363	954
27	5- 6	15	294	336	294	292	356	292	1,112
	15-16	5	168	192	156	163	195	163	1,200
	25-26	15	270	294	246	259	300	259	1,160
	35-36	5	234	288	252	243	300	243	1,098
28	5- 6	15	-	-	354	-	-	-	-
	15-16	5	228	282	228	228	279	228	1,113
	35-36	5	306	354	264	288	367	288	1,003
29	5- 6	5	378	528	342	365	525	365	650
	15-16	15	462	564	438	-	-	-	-
	25-26	5	-	-	384	-	-	-	-
	35-36	15	-	-	426	-	-	-	-

Table 5.--Observed (sounding tube) and theoretical (computed) hook depths for cruise 27 of the Charles H. Gilbert

Station	Hookless gear between baskets	Float-line gear (fm.)	Hooks						Computed buoy distance (feet)
			Observed depth (feet)			Theoretical depth (feet)			
			4	7	10	4	7	10	
1	5- 6	5	306	444	348	331	443	331	854
	15-16	15	396	492	378	385	492	385	881
	25-26	5	312	414	318	315	415	315	919
	35-36	15	438	564	438	433	607	433	574
3	5- 6	15	444	594	444	440	633	440	485
	15-16	5	330	498	402	-	-	-	-
	25-26	15	-	624	504	-	-	-	-
	35-36	5	420	534	342	-	-	-	-
5	5- 6	5	294	516	-	-	-	-	-
	15-16	15	453	-	-	-	-	-	-
	25-26	5	354	564	408	-	-	-	-
	35-36	15	456	594	444	-	-	-	-
6	5- 6	15	504	>600	444	-	-	-	-
	9-10	5	-	534	426	-	-	-	-
	25-26	15	426	486	372	401	522	401	815
	35-36	5	336	474	330	339	455	339	828
8	5- 6	5	372	516	384	377	559	377	540
	15-16	15	372	>600	552	-	-	-	-
	25-26	5	402	558	384	-	-	-	-
	35-36	15	384	594	426	422	570	422	692

Table 6.--Observed (sounding tube) and theoretical (computed) hook depths for cruise 25 of the John R. Manning

Station	Hookless gear between baskets	Float-line gear (fm.)	Hooks						Computed buoy distance (feet)
			Observed depth (feet)			Theoretical depth (feet)			
			4	7	10	4	7	10	
1	25-26	5	186	216	150	176	213	176	1,192
3	"	15	-	-	246	-	-	-	-
5	"	15	402	504	384	392	503	392	860
7	"	5	348	354	306	324	430	324	837
9	"	5	318	414	324	320	418	320	866
11	"	5	150	186	174	162	193	162	1,205
13	"	15	294	306	252	275	325	275	1,138
15	"	5	258	336	270	266	336	266	1,050
17	"	15	294	378	306	305	364	305	1,092
18	"	5	270	348	282	276	350	276	1,031
19	26-27	15	384	396	-	-	-	-	-
20	25-26	15	390	426	324	360	450	360	964
21	"	5	390	444	288	-	-	-	-
22	"	15	378	474	360	372	467	372	925

Table 7.--Observed (sounding tube) and theoretical (computed) hook depths for cruise 26 of the *John R. Manning*

Station	Hookless gear between baskets	Float-line gear (fm.)	Hooks						Computed buoy distance (feet)
			Observed depth (feet)			Theoretical depth (feet)			
			4	7	10	4	7	10	
1	25-26	15	474	>600	486	-	-	-	-
2	"	5	324	426	282	312	409	312	923
4	"	15	432	534	432	426	588	426	637
6	26-27	15	342	474	378	366	459	366	948
8	25-26	5	300	-	276	-	-	-	-
10	"	15	336	402	330	333	405	333	1,035
12	"	5	330	438	366	346	474	346	784
14	"	15	402	480	360	384	488	384	887
16	"	5	318	414	324	319	420	319	907
18	"	15	402	516	390	397	515	397	830
24	"	5	306	372	288	296	382	296	975
26	"	15	414	534	402	407	537	407	781
28	"	5	306	402	288	301	392	301	960
30	"	5	270	-	318	-	-	-	-
32	"	15	384	486	384	385	488	385	891
34	"	15	354	420	-	-	-	-	-
36	"	5	312	390	-	-	-	-	-
38	"	15	384	474	360	374	471	374	917
40	"	15	-	486	-	-	-	-	-
42	"	5	306	366	294	298	383	298	974
43	"	5	282	366	282	289	370	289	996
48	"	5	360	444	330	343	470	343	793
50	"	15	384	444	342	384	490	384	883
51	"	5	336	396	306	319	418	319	906
53	"	15	402	516	402	401	522	401	814
54	"	5	336	426	324	328	440	328	861
55	"	15	426	564	504	-	-	-	-
57	"	5	258	330	246	256	320	256	1,071
59	"	15	432	558	402	418	566	418	701
61	"	5	258	324	258	258	322	258	1,067
63	"	15	426	534	360	408	548	408	774
64	"	5	324	408	282	308	401	308	937
65	"	15	432	570	432	422	582	422	643
66	"	5	288	402	312	303	395	303	953
67	"	15	402	534	402	402	530	402	793
68	"	5	240	306	234	240	299	240	1,096
69	"	15	426	540	414	420	567	420	698

Table 8.--Observed (sounding tube) and theoretical (computed) hook depths for cruise 29 of the Hugh M. Smith

Station	Hookless gear between baskets	Float-line gear (fm.)	Hooks Observed depth (feet) 4	7	10	Theoretical depth (feet) 4	7	10	Computed buoy distance (feet)
1	25-26	15	258	282	234	245	285	245	1,178
5	"	15	378	474	366	374	470	374	923
7	"	5	210	264	222	218	267	218	1,136
9	24-25	15	318	408	324	325	395	325	1,050
13	25-26	5	318	396	306	310	406	310	933
15	24-25	5	330	492	354	348	477	348	782
16	"	15	408	462	342	380	484	380	898
19	"	5	-	306	246	-	-	-	-
21	25-26	15	318	408	324	325	395	325	1,050
23	"	5	324	372	276	300	389	300	963
25	"	15	444	582	444	440	642	440	446
27	"	5	276	354	264	273	346	273	1,034
29	"	15	420	594	414	422	574	422	684
36	"	15	342	474	372	365	455	365	951
37	"	5	288	378	288	290	370	290	1,002
39	"	15	330	402	318	325	394	325	1,057
41	"	5	300	408	300	305	395	305	952
42	"	5	360	462	336	349	477	349	775
43	"	15	396	522	444	425	582	425	632
44	"	5	288	366	282	295	378	295	982
45	"	15	426	558	402	417	562	417	712
46	"	5	324	432	330	331	434	331	873
47	"	15	396	552	438	420	566	420	686
48	"	5	312	414	-	-	-	-	-
49	"	15	426	474	354	400	518	400	822
50	"	5	318	396	300	308	400	308	942

Table 9.--A comparison of skewness[1] with current velocity or longline drift, shearing[2] and wind speed for the *John R. Manning* cruises 25 and 26, the *Charles H. Gilbert* cruises 23 and 27, and the *Hugh M. Smith* cruise 29

Cruise	Period	Station	Skewness	Mean drift velocity (knots)	Possible shearing effect	Wind speed (knots)
Manning-25	5/2-6/9/55	1	36	0.60	2.667	3
		5	18	1.26	1.143	3
		7	42	0.69	1.600	5
		9	6	0.33	1.411	14
		11	24	0.33	3.000	4
		13	42	0.13	1.846	14
		15	12	0.35	1.714	13
		17	18	0.21	1.500	7
		18	12	0.32	0.400	7
		20	66	0.38	1.333	10
		21	102	0.48	1.333	9
		22	18	0.27	1.200	6
Manning-26	7/15-9/7/55	1	12	0.38	0.208	19
		2	42	0.39	0.294	19
		4	0	0.0	0.286	13
		6	36	0.24	0.263	13
		10	6	0.35	0.312	8
		12	36	0.50	0.222	13
		14	42	0.41	0.210	8
		16	6	0.43	0.235	13
		18	12	0.24	0.190	8
		24	18	0.24	0.267	13
		26	12	0.0	0.238	5
		28	18	0.0	0.375	5
		32	0	0.0	0.210	8
		34	84	0.68	0.235	13
		38	24	0.29	0.263	13
		42	12	0.18	0.333	13
		43	6	0.79	0.333	19
		45	90	0.44	0.167	19
		48	30	0.20	0.222	13
		50	42	0.43	0.222	24
		51	30	0.31	0.250	19
		53	0	0.53	0.286	13
		54	12	0.47	0.588	13
		55	78	0.13	0.261	8
		57	12	0.10	1.231	8
		59	30	0.31	0.273	5
		61	0	0.38	0.385	8
		63	66	0.31	0.143	5
		64	42	0.11	0.250	5
		65	0	0.24	0.217	5

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[1] A measure determined by the difference of hook 4 and 10 of hookless baskets between baited baskets 25 and 26.

[2] A measure determined by the ratio of the depth of hook 7 to the depth of the top of the thermocline.

Table 9.--A comparison of skewness with other factors affecting the longline (cont'd)

Cruise	Period	Station	Skewness	Mean drift velocity (knots)	Possible shearing effect	Wind speed (knots)
Manning-26 (cont'd)	7/15-9/7/55	66	24	0.16	0.062	13
		67	0	0.17	0.143	8
		68	0	0.30	0.167	1
		69	12	0.43	0.364	8
Gilbert-23	9/15-11/2/55	16	18	0.39	0.417	11
		17	96	0.27	0.385	12
		18	0	0.38	0.300	12
		19	24	0.35	0.333	10
		20	0	0.36	0.500	13
		27	24	0.29	0.667	28.5[3]
Gilbert-27	3/15-5/4/56	1	6	0.26	0.353	8
		3	120	0.15	0.541	10
		5	54	0.12	0.478	13
		6	54	0.0	0.650	19
		8	18	0.0	0.087	14
Smith-29[4]	5/2-6/22/55	1	24		2.182	16
		5	12		1.263	16
		7	12		2.182	13
		9	6		1.500	11
		13	12		1.500	19
		15	24		1.263	30
		16	66		1.333	9
		21	6		0.188	19
		23	58		0.267	18
		25	0		1.043	19
		27	12		1.714	16
		29	12		1.000	20
		36	30		0.263	23
		37	0		3.333	11
		39	12		0.200	9
		41	0		1.375	11
		42	24		0.889	19
		43	48		1.048	17
		44	6		1.600	14
		45	24		1.091	14
		46	6		1.412	16
		47	58		1.091	6
		49	78		1.263	24
		50	18		1.500	22

[3] This is the mid-point of 17 and 40 knots, the range of the wind speed during the fishing time of this set.

[4] There were no readings of the mean drift velocity for *Smith* cruise 29 because the raw data were unreliable.

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Some Trematodes of Fishes from the Central Equatorial Pacific

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THIS REPORT is based on a collection of trematodes from marine fishes captured in the vicinity of the Line Islands. All the trematode species listed are believed to constitute first records from this area, and some are first reports from new hosts. Collections were made in 1955 during exploratory tuna fishing by trolling and longlining. These fishing surveys were carried out by Pacific Oceanic Fishery Investigations (POFI), a branch of the U. S. Fish and Wildlife Service, as one phase of a program designed to determine the distribution and abundance of tunas in the Pacific. The Line Islands from which this material was collected are: Christmas, Fanning, Washington, and Palmyra islands, and Kingman Reef. They extend in a northwesterly direction from 2° N. latitude, 157° W. longitude to 6° N. latitude, 163° W. longitude.

All specimens, except the hemiurids, were identified through the kind efforts of Dr. Harold W. Manter, Department of Zoology, University of Nebraska. Unfortunately facilities were not available aboard ship for proper preservation of such material; as a result many of the specimens were identified with difficulty and some could not be accurately identified. Dr. Donald C. Matthews, Department of Zoology, University of Hawaii, very kindly provided sections of the encysted didymocystid included herein. Thanks are extended to E. Dixon Stroup, POFI, for making the photographs used in this report. All collections have been deposited in the U. S. National Museum.

Order MONOGENEA

Family MICROCOTYLIDAE

Neothoracocotyle acanthocybii (Meserve, 1938)

SYNONYMS: *Gotocotyla acanthocybii* Meserve, 1938.

HOST: Wahoo, *Acanthocybium solandri* (Cuvier and Valenciennes).

LOCATION: Between gill filaments.

LOCALITY: Kingman Reef, 6° 20′ N., 162° 30′ W.

SPECIMENS: USNM Helm. Coll. No. 38132.

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: *Acanthocybium solandri* from the Galapagos Islands.

DISCUSSION: Since these parasites are located between the gill filaments, they are found only by rather close scrutiny. Other duties while at sea prevented a careful record of the number of infected fish. The number of worms per host is probably large and the rate of infestation high. Hargis (1956), who has erected the genus *Neothoracocotyle*, reported the new combination.

Family CAPSALIDAE

Capsala poeyi (Vigueras, 1935) Price, 1938

SYNONYMS: *Tristomum poeyi* Vigueras, 1935.

HOST: Black marlin, *Makaira ampla*[3] (Poey).

LOCATION: Outside surface on isthmus and second dorsal fin.

LOCALITY: 04° 48′ N., 160° 37′ W. (vicinity of Washington Island).

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[3] Identification of the Pacific *M. ampla* was based on an unpublished key provided by Dr. William F. Royce. As this paper goes to press, it is apparent that there is considerable disagreement concerning the classification of the marlins.

SPECIMENS: USNM Helm. Coll. No. 38131.

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: Reported from the same species of host off Havana, Cuba, by Vigueras (1935).

Capsala biparasitica (Goto, 1894) Price, 1938

SYNONYMS: *Tristoma biparasitica* Goto, 1894.

HOST: Yellowfin tuna, *Neothunnus macropterus* (Temminck and Schlegel).

LOCATION: Firmly attached to carapace of copepods found in gills.

LOCALITY: 02° 14′ N., 159° 59′ W. (vicinity of Christmas Island).

SPECIMENS: USNM Helm. Coll. No. 38134.

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: Goto collected this species of trematode from a copepod (*Parapetalus* sp.) on *Thynnus albacora* from Misaki, Japan.

DISCUSSION: The copepod involved in the present record is *Elytrophora* sp. A comparison of these host records is of particular interest because the trematode is a hyperparasite and because in each collection both the copepod hosts are caligid copepods and the fish hosts are closely related.

Family HEXASTOMATIDAE

Hexostoma grossum (Goto, 1894) Sproston, 1946

SYNONYMS: *Hexacotyle grossa* Goto, 1894.

HOST: Bigeye tuna, *Parathunnus sibi* (Temminck and Schlegel).

LOCATION: On gills.

LOCALITY: 02° 45′ N., 158° 05′ W.

SPECIMENS: USNM Helm. Coll. No. 38133.

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: On gills of *Thynnus* sp. from Misaki, Japan (Goto, 1894); type host corrected to *Parathunnus sibi* and reported on gills of *Katsuwonus vagans* and *Thunnus orientalis*, and on *Seriola quinqueradiata* from Japan (Ishii and Sawada, 1938).

Order **DIGENEA**

Family HEMIURIDAE

Hirudinella marina Garcin, 1730

SYNONYMS: Nigrelli and Stunkard (1947 include a very lengthy list of possible synonyms of this species.

HOST: Yellowfin tuna, *Neothunnus macropterus* (Temminck and Schlegel).

LOCATION: In stomach.

LOCALITY: 06° 20′ N., 162° 30′ W. (vicinity of Kingman Reef).

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: Nigrelli and Stunkard (1947) include a long list of hosts, mostly of scombriform fishes, including *N. macropterus* from C. San Lucas, Lower California, Pacific.

DISCUSSION: In the course of the examination of stomach contents of yellowfin and bigeye tuna from the central Pacific, King and Ikehara (1956) encountered large muscular trematodes. They report an infection rate of 32 per cent for 166 bigeye and 26 per cent for the 439 yellowfin they examined. Since Nigrelli and Stunkard recognize only two species of *Hirudinella*, one in the wahoo, *H. ventricosa*, and one in other hosts, *H. marina*, it is very likely that these worms belong to the latter species.

Hirudinella ventricosa Pallas, 1774

SYNONYMS: Nigrelli and Stunkard (1947 list nine possible synonyms.

HOST: Wahoo, *Acanthocybium solandri* (Cuvier and Valenciennes).

LOCATION: Stomach.

LOCALITY: Christmas, Fanning, Washington, Palmyra islands, and Kingman Reef.

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: *Acanthocybium solandri* in the Atlantic and Pacific; from the Pacific it has been reported from Panama, Mexico, Equador, and the Marianas Islands (Nigrelli and Stunkard, 1947).

DISCUSSION: Nigrelli and Stunkard (1947) have made a thorough study of this genus and regard all *Hirudinella* reported from the wahoo as belonging to a single species, *H. ventricosa* Pallas. In an examination of 220 wahoo stomachs from the Line Islands, Iversen and Yoshida (1957) found a 98.2 per cent infection of these parasites. The hosts ranged in size from 108 to 172 cm. and as many as 17 of the worms were found in a single stomach, with 2 per host occurring most frequently.

H. ventricosa may be present elsewhere in the Pacific, for Edmondson (1946) states in respect to the Hawaiian region, that "An undetermined species of trematode commonly occurs in the stomach of the Ono, *Acanthocybium solandri* (Cuvier)." These flukes were about 1 inch long when partially contracted. Kishinouye (1923) in speaking of wahoo from Japan says "A large distomum, about 8 cm. in length, is almost always found in the stomach."

Family DIDYMOZOONIDAE

Didymocystis acanthocybii
Yamaguti, 1938

HOST: Wahoo, *Acanthocybium solandri* (Cuvier and Valenciennes).

LOCATION: Base of gill arches and on operculum.

LOCALITY: Christmas, Fanning, Washington, Palmyra islands, and Kingman Reef.

SPECIMENS: USNM Helm. Coll. No. 38171.

PREVIOUSLY REPORTED HOSTS AND LOCALITIES: At base of gill arch of *Acanthocybium sara* (Lay et Bennett); Pacific, Japan, Yamaguti (1938).

DISCUSSION: Of the 104 wahoo examined, 53 revealed conspicuous cysts of this parasite (Fig. 1). The fish ranged in size from 86 to 174 cm., and specimens of all sizes within this range were found to be infected. Figure 2 shows the relationship of the paired worms within the cyst.

Didymocystis sp.

HOST: Yellowfin tuna, *Neothunnus macropterus* (Temminck and Schlegel).

LOCATION: On gill filaments.

LOCALITY: 00° 28′ N., 157° 48′ W.

SPECIMENS: USNM Helm. Coll. No. 38172.

DISCUSSION: The condition of specimens does not permit identification, but they resemble *D. wedli* Ariola, 1902, more closely than others. The infection rate of yellowfin is probably not high.

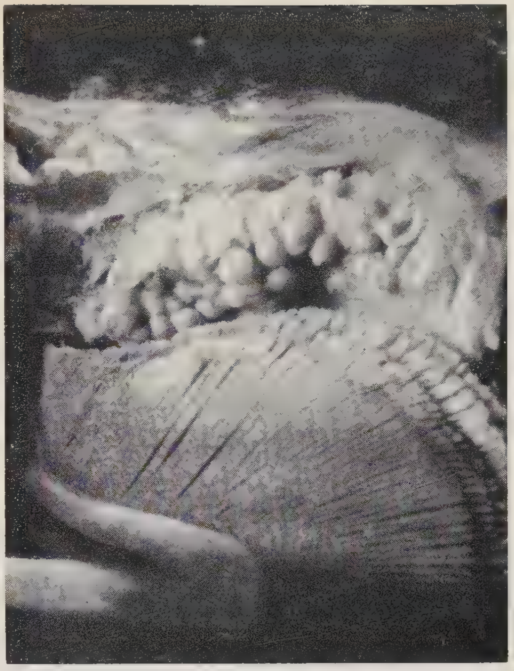

FIG. 1. Photograph of encysted *Didymocystis acanthocybii* on the side of the head of a wahoo (gill cover removed).

DISCUSSION

Concomitant studies of hosts and parasites from different geographic areas have been reviewed by Metcalf (1929) and Manter (1955), who have presented considerable evidence that parasites reflect the distribution and way of living of their hosts. A basic problem in the study of some pelagic fishes is to determine whether the population of each important species is continuous throughout its range or whether it is composed of a number of independent or semi-independent units. In this connection these records, especially of Monogenea which are host specific, are of interest. *Capsala biparasitica* from yellowfin tuna in Japan and the Line Islands, *Hexastoma grossum* from bigeye in Japan and the Line Islands, *Neothoracocotyle acanthocybii* from wahoo in the Line and Galapagos islands, and *Capsala poeyi* from the black marlin in the Atlantic and Pacific, all suggest that these stocks of fish are not, or were not, completely independent.

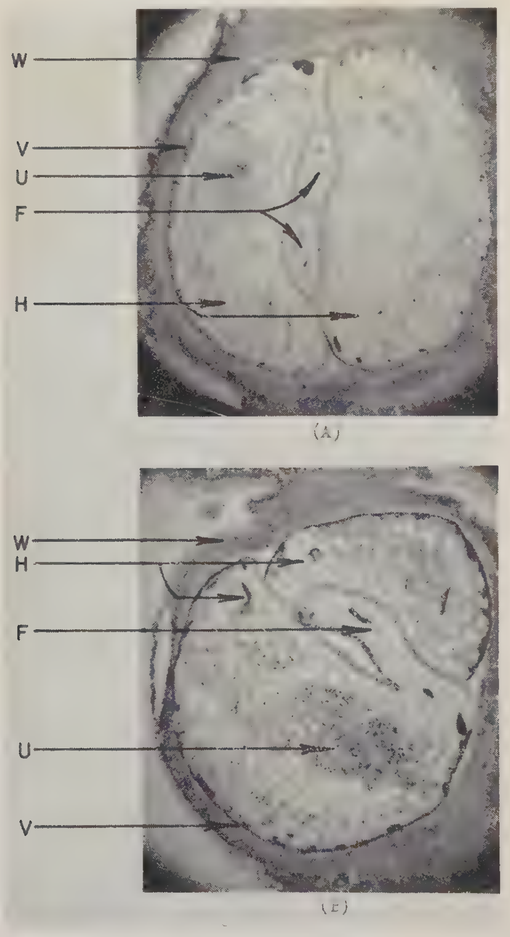

FIG. 2. *Didymocystis acanthocybii.* (A) Photomicrograph of a cross section through two trematodes showing the host tissue (W) surrounding the cyst, the forebodies (F), the hindbodies (H), the uterus (U), and vitellarium (V) of each. (B) Photomicrograph of a section through two trematodes showing the forebody of one in sagittal section. 10 microns.

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A NEW METHOD OF HANDLING LONG-LINE GEAR USING A ROTATING TUB

By Herbert J. Mann*

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ABSTRACT

A considerable savings in manpower may be effected by operating tuna long-line gear from a rotating tub rather than by handling it in the conventional manner. Instead of using individual baskets of line which must be separated and joined together for each day's fishing, a continuous mainline is set from, and hauled into a wooden storage drum. Conventional gear requires but few changes to fit it for the new method of operation.

INTRODUCTION

This is the third report on the construction and operation of the long-line gear used by the Pacific Oceanic Fishery Investigations (POFI), U. S. Fish and Wildlife Service, in a program of exploratory tuna fishing in central Pacific waters. It describes a new technique for handling long-line gear called the "tub" method, which saves manpower as compared with conventional long-line fishing methods. Earlier descriptions of the design and operation of long line, as developed at POFI, were given by Niska (1953) and Mann (1955).

In this report, "long-lining" refers to the set-line method of fishing used in the Japanese and Hawaiian high-seas fisheries for tunas and spearfishes. The gear is constructed so that a series of baited hook droppers is suspended from a long mainline, usually several miles in length; the mainline is buoyed up at regular intervals by buoys and floatlines. Unanchored, the gear drifts with wind and current with the hooks fishing at 100 to 500 feet below the surface.

The Japanese have found long-lining to be an effective way of harvesting tuna, and a large part of the Japanese commercial tuna catch is taken by this means. The long line, however, is not utilized to any great extent by United States fishermen. Two major drawbacks to this method of fishing, as now practiced, have prevented its general acceptance by the American industry. First, the method is nonselective, as far as catch is concerned, so that fish of various species and sizes are taken on the gear. This presents no hindrance in a fresh-fish economy such as Japan possesses, in which there is a steady market demand for fresh fish of all types, but it does present some problems to the United States canning industry accustomed to dealing with fish of uniform size and species. Secondly, a comparatively large number of men are required for long-lining. The relatively low concentration of tuna in most regions of the open sea makes it necessary to set a large amount of gear over a wide area in order to insure a commercial return. Japanese vessels, fishing from 1,200 to 1,500 hooks a day, require more than 20 men for assembling, baiting, setting, hauling, and restowing the gear. An American purse seiner or live-bait vessel of comparable tonnage usually has a crew of about 12 men.

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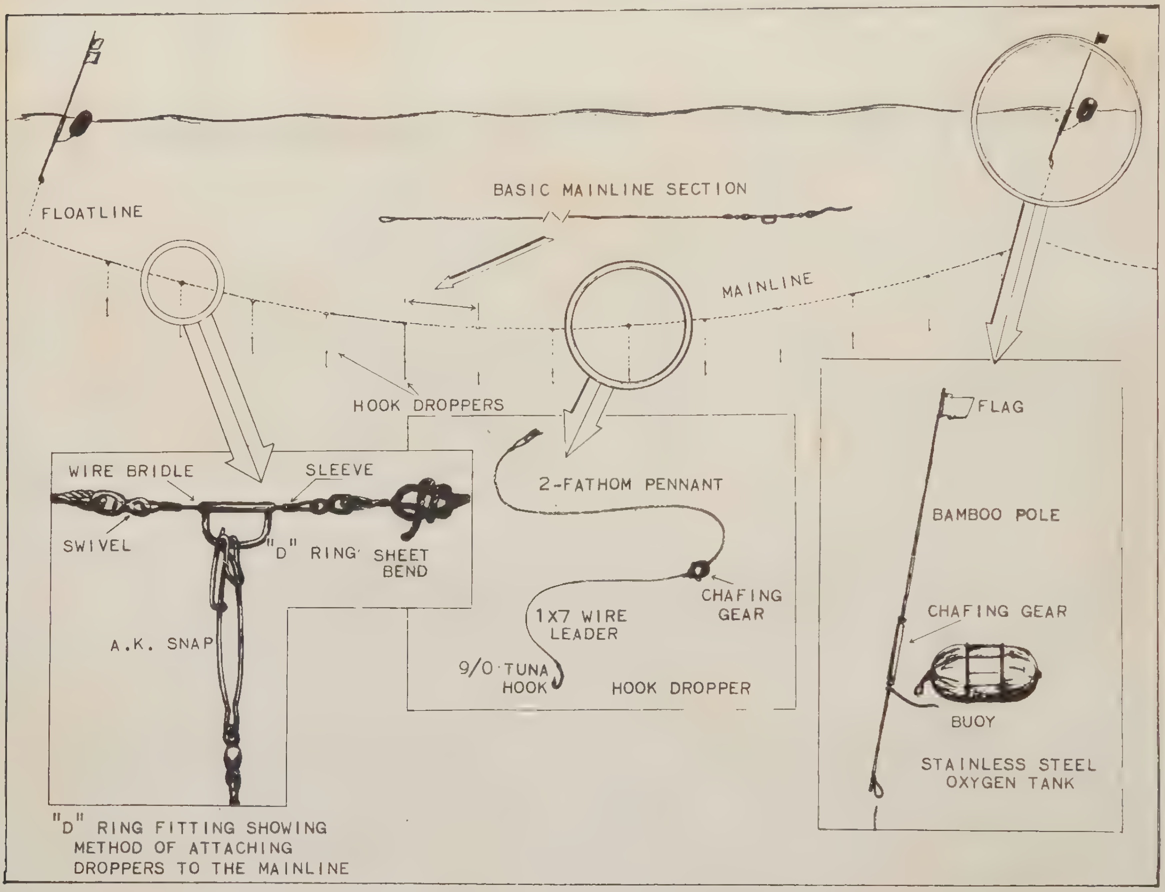
FLOATLINE
BASIC MAINLINE SECTION
MAINLINE
HOOK DROPPERS
WIRE BRIDLE
SLEEVE
SWIVEL
"D" RING
SHEET BEND
A.K. SNAP
"D" RING FITTING SHOWING METHOD OF ATTACHING DROPPERS TO THE MAINLINE
2-FATHOM PENNANT
CHAFING GEAR
1X7 WIRE LEADER
9/0 TUNA HOOK
HOOK DROPPER
FLAG
BAMBOO POLE
CHAFING GEAR
BUOY
STAINLESS STEEL OXYGEN TANK

Fig. 1 - Schematic diagram of one basket of tub gear.

POFI has made several attempts to modify the long line so as to reduce the number of men necessary to operate the gear. For example, a "drum line," which consisted of a mainline in one continuous length reeled on a wooden drum instead of being broken down into separate units was tried experimentally. In another scheme, wire rope was substituted for cotton twine for the mainline, and high-speed multiple-drum winches were used to set and retrieve the gear. In both of these methods difficulty was experienced with winch inertia problems and with the devices for attaching droppers to the mainline in the setting operation. Neither scheme offered enough promise to justify the continuation of its development.

RECENT INNOVATIONS

The latest modification of tuna long-lining, the tub method described here, has proven successful in experimental fishing. With this method, the mainline, in one continuous length, is set from, and hauled into the wooden storage tub that gives this method its name. The droppers and floatlines are detachable and are removed from the mainline during hauling operations and reattached during the setting process.

By eliminating the handling of the mainline, a considerable saving in labor is effected. Fishing cruises aboard the Bureau's research vessels John R. Manning and Commonwealth, during which the new method and the conventional method of handling gear were compared, showed that the usual POFI set of from 60 to 100 baskets of gear could be made by 5 men, or less, using the tub method, whereas, the full crew of 11 men was necessary to operate conventional gear.

Shown in figure 1 is a schematic representation of one basket of POFI experimental long line. Except for the "D" ring (shown in the insert, lower left), the gear is of the standard POFI design described in detail in a previous report (Mann 1955). The "D" ring, a nonstandard fitting designed by POFI, is also a new development. Its function is to provide free-swivelling action between dropper and mainline at any angle of pull. Formerly the AK snaps were clipped directly to the wire bridle. This means of attachment ordinarily permitted the dropper to swivel around the mainline and thus prevented tangles of dropper and mainline, when the gear was being hauled

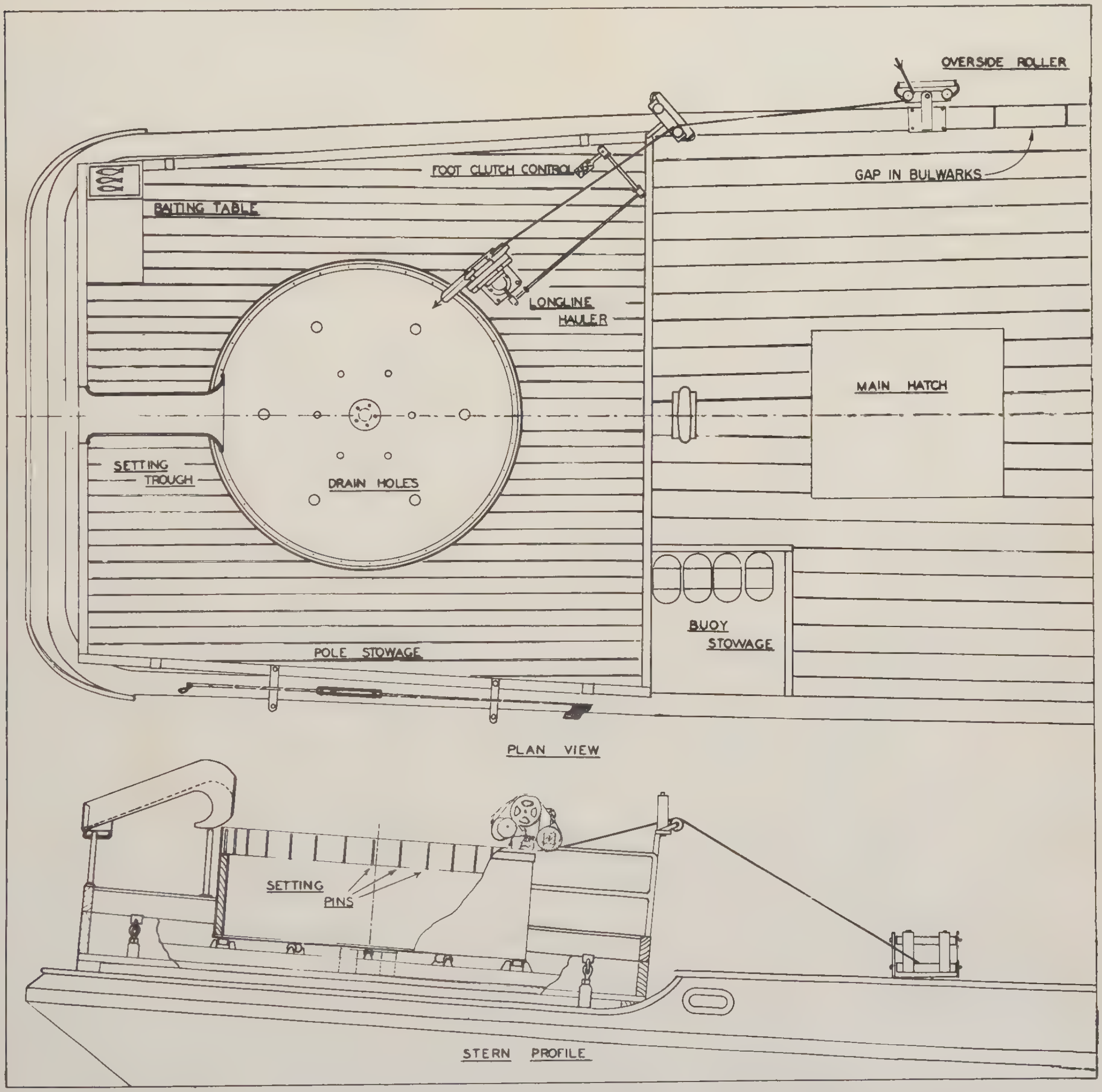
OVERSIDE ROLLER
GAP IN BULWARKS
FOOT CLUTCH CONTROL
BAITING TABLE
LONGLINE HAULER
MAIN HATCH
SETTING TROUGH
DRAIN HOLES
BUOY STOWAGE
POLE STOWAGE
PLAN VIEW
SETTING PINS
STERN PROFILE

Fig. 2 - Installation of the line-stowage tub on the John R. Manning.

aboard the vessel, but it frequently failed to function properly when large fish pulled the dropper parallel to the mainline. At acute angles under strong tension, the snap ceased to have any swivelling action and sometimes was pulled out of shape or broken.

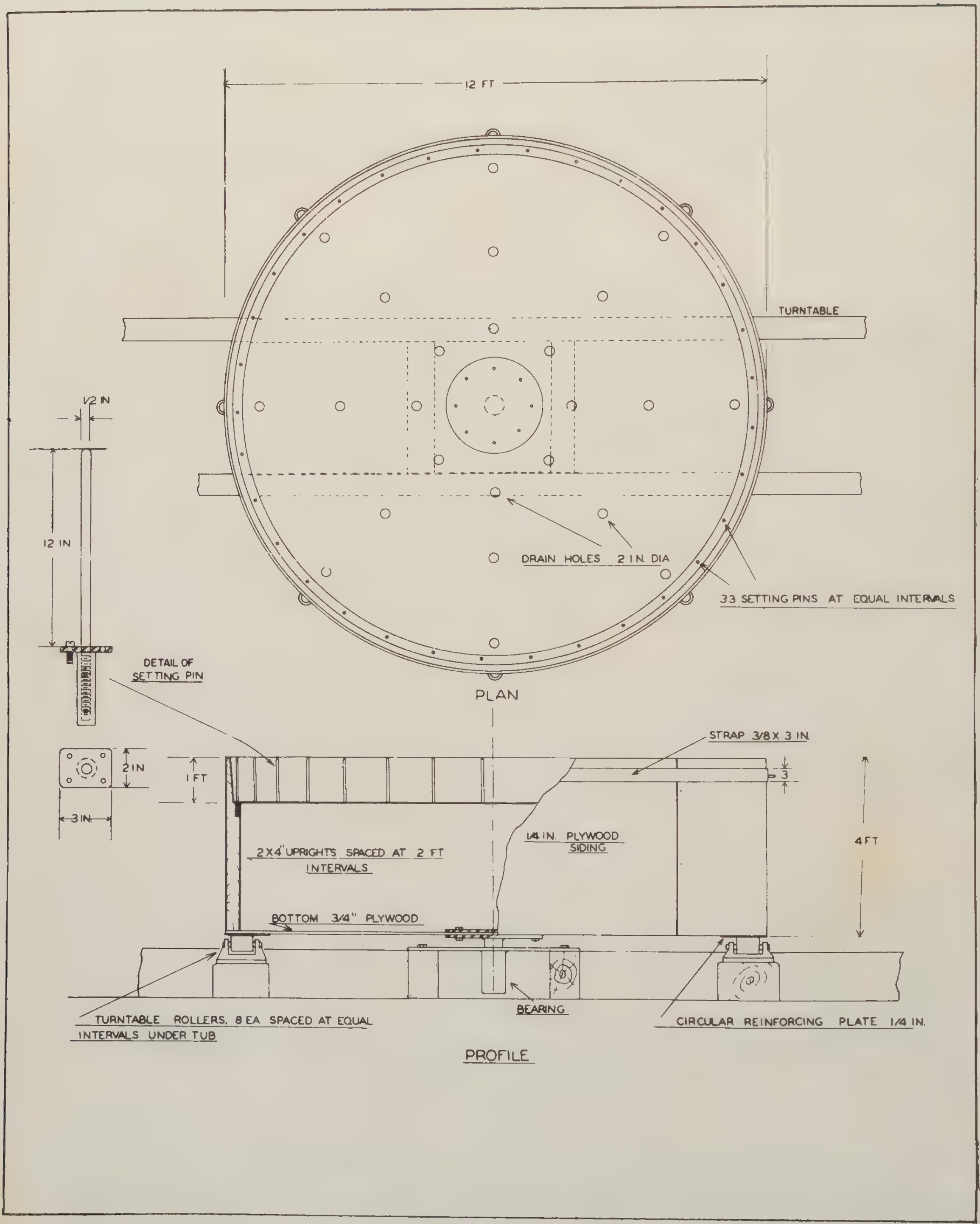
12 FT
TURNTABLE
1/2 IN
12 IN
DRAIN HOLES 2 IN. DIA
33 SETTING PINS AT EQUAL INTERVALS
DETAIL OF SETTING PIN
PLAN
STRAP 3/8 X 3 IN
3
2 IN
1 FT
3 IN
4 FT
1/4 IN. PLYWOOD SIDING
2 X 4" UPRIGHTS SPACED AT 2 FT INTERVALS
BOTTOM 3/4" PLYWOOD
TURNTABLE ROLLERS, 8 EA SPACED AT EQUAL INTERVALS UNDER TUB
BEARING
CIRCULAR REINFORCING PLATE 1/4 IN.
PROFILE

Fig. 3 - Construction details of line storage tub.

The new "D" ring maintains proper swivelling action with the dropper leading in any direction. The rings are fabricated from a section of stainless steel tubing $\frac{5}{16}$-inch outside diameter and $\frac{3}{32}$-inch inside diameter. The lower section of $\frac{3}{16}$-inch diameter stock is formed in a U-shape and welded to the tube section. The rings are threaded on a wire bridle made up of a 6-inch length of $\frac{3}{32}$-inch diameter 7 x 7 stainless steel wire rope. Wire loops holding brass swivels at each end of the bridle are made by pressing Nicopress fittings on the wire with a hand tool. Swivels are used to relieve torque which develops while the long line is being brought in by the hauler.

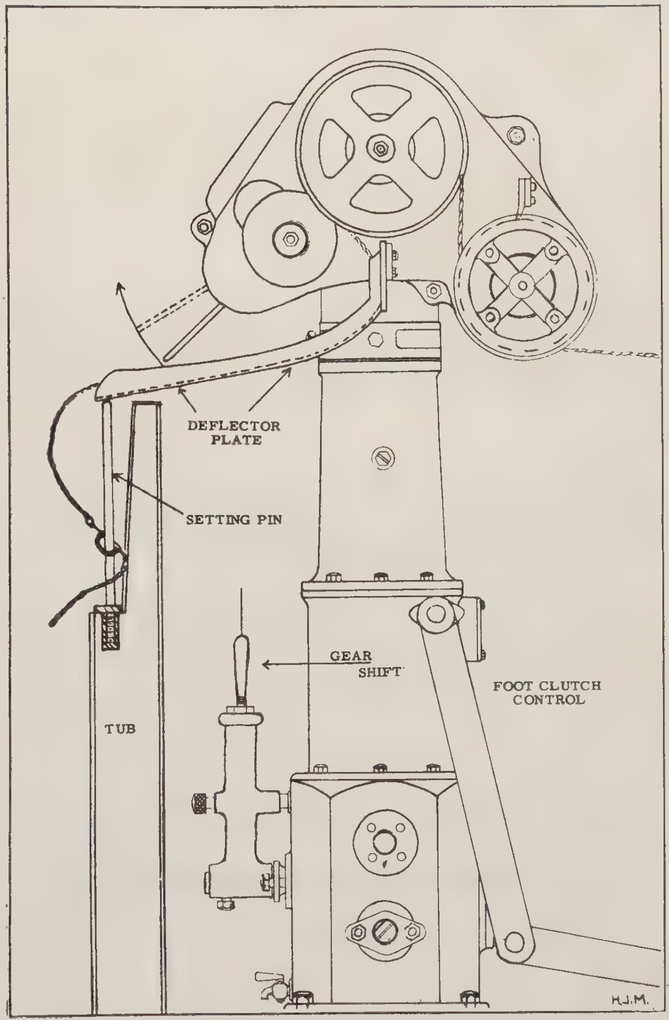

Fig. 4 - Arrangement of the tub and long-line hauler.

CONSTRUCTION OF THE TUB

Figure 2 is a schematic representation of the experimental long-line tub installed on the M/V John R. Manning. The tub is mounted on the stern turntable in the space normally occupied by the purse seine on this type of vessel. Ample work space is left on all sides between the tub and the railing. A heavy combination thrust and side bearing, bolted to the main deck, permits the tub to rotate in either direction. The bottom rim of the tub, reinforced with a circular steel plate, runs on a set of 8 cast-iron rollers formerly used to support the purse-seine turntable. The deck gratings and railing on top of the turntable provide a safe working space above the wash of the seas and make the tub easily accessible during fishing operations.

Figure 3 shows construction details of the tub. Inner and outer shells of the tub consist of panels of $\frac{1}{4}$-inch marine plywood with the grain running vertically. The two shells are separated by 2 x 4-inch uprights. The bottom is constructed of two panels of $\frac{3}{4}$-inch plywood. Two-inch drain holes are spaced at intervals around the bottom. The tub is strengthened by circular steel bands of $\frac{3}{8}$- x 3-inch strap welded to form rings around the outside walls.

Setting pins, of $\frac{1}{2}$-inch diameter x 12-inch length, made from stainless steel rod, are spaced at equal intervals around the rim inside the tub. The pins are threaded into stainless steel bases firmly mounted on the step. These pins are securely mounted because severe strains are exerted on them during hauling operations when the mainline is packed down into the tub by trampling upon it.

The tub on the John R. Manning is $11\frac{1}{2}$ feet inside diameter and 4 feet in height. This size allows for storage of 100 baskets of POFI mainline gear. The tub, as presently designed, is rotated by hand. If large amounts of long-line gear are to be fished commercially, some system of turning the tub by power is desirable.

THE SETTING TROUGH

The setting trough (fig. 2) is a demountable sheet metal form used to confine and guide the outgoing mainline during the setting process. In general appearance it is similar to the type used in the halibut fishery of the eastern North Pacific. The inboard lip of the trough is mounted above the tub edge and slightly inboard of the setting pins. In the original installation, some difficulty was experienced in getting the "D" rings to lift smoothly from their setting pins. It was necessary, therefore, to make the trough easily adjustable in height and distance in respect to the tub edge so that the proper relation between pin and trough could be established.

THE LONG-LINE HAULER

The gear is hauled by a conventional Japanese long-line hauler. This type of winch, turning at high speed with low inertia, is especially adapted to the long-line operation in which the mainline must be stopped frequently so that droppers can be removed.

The hauler is mounted on the turntable as close as possible to the edge of the tub. Because of the projecting gear shift lever of the winch, the hauler cannot be mounted with its inboard sheave over the tub and a deflector plate is used to bridge the gap between hauler and tub (see fig. 4). This plate is adjustable so that the incoming line can be thrown at various angles by changing the height of the inboard end of the plate.

The hauler is controlled by a foot clutch mounted at the rail, so that the winch operator has a clear view of the line coming aboard. To aid in landing fish, the line is led through overside rollers mounted on the starboard side of the main deck. The droppers and floatlines are detached at this lower level.

On POFI vessels the long-line hauler is driven by a 3 hp. electric motor through a 5:1 gear reduction, or by a 14 hp. hydraulic drive. An input speed of 300 revolutions per minute yields a line speed of about 1,000 feet per minute in high gear and 500 feet per minute in low gear.

OPERATION OF THE GEAR

Before leaving on a fishing cruise, baskets of mainline are knotted together and fed through the line hauler and stowed in the storage tub. No attempt is made to coil the line down uniformly but it is distributed on the bottom of the tub by changing the angle of the deflector plate from time to time so that line is thrown from one side of the tub to the other.

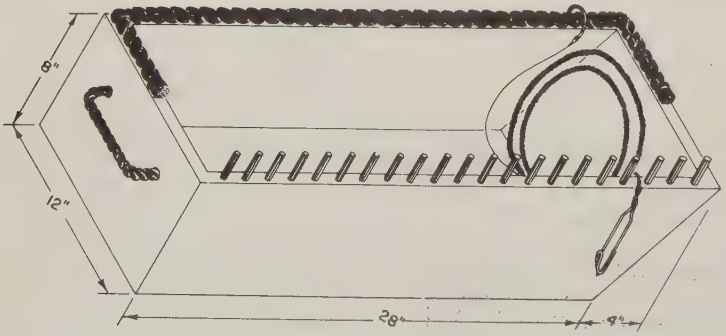

Fig. 5 - Dropper stowage box.

As the "D" rings pass through the hauler they are caught by one fisherman and threaded on the setting pin nearest the winch (see fig. 4). All rings for one basket are placed on a single pin and the cloverleaf knot marking the end of the basket is looped on top. The tub is then turned by hand until an alternate pin comes in line with the winch. (Rings of successive baskets are threaded on alternate pins to prevent lines from piling up too much in one place.) After the tub has made one complete revolution the process is repeated until three layers of 33 baskets each are in place. The tub is covered by a tarpaulin to keep the line from being disarranged before setting.

SETTING OPERATION: When setting the gear, the vessel is steered on a desired course at speeds up to nine knots. The tub is turned until the setting pin of the top basket lines up with the center of the setting trough. The end of the mainline is led through the setting trough. The floatline and buoy with pole are attached and the assembly is thrown overboard. Thereafter the drag of the end basket pulls the mainline from the tub.

The hook droppers are baited with sardines or herring. The AK snap, at the upper end of the dropper, is snapped on to the "D" ring without removing the "D" ring from its pin, and the dropper is then laid in the trough with the bait dangling overboard. The outgoing mainline snatches the ring and dropper from the pin and carries them overboard. Floatlines are snapped on in the same manner.

HAULING: The gear is hauled in the normal fashion by running the mainline through the longline hauler and into the tub. As the droppers come aboard, the winch is stopped momentarily and the snaps are removed from the "D" rings. The droppers are coiled and packed in specially designed plywood boxes (fig. 5). These have sloping ends to facilitate stowing the coils on edge. The hooks and snaps are secured to opposite sides of the box as shown. The "D" rings are threaded on pins as described before. Fish are gaffed and brought aboard through the gap in the rail shown in figure 2.

DISCUSSION

EVALUATION OF THE METHOD: Although still in the experimental stage, and with a great deal of developmental work yet to be done, the tub method appears to be commercially practicable. When employing the usual methods, POFI crews, consisting ordinarily of 11 men, fishing 60 to 100 baskets of gear, must break out, assemble, disassemble, and restow from 1 to 2 tons of wet line for each day's fishing. By eliminating the handling of the mainline, the size of the fishing crews may be reduced by more than one-half. Operation times for both methods are about the same, averaging about 3½ minutes per basket for hauling gear and 2½ minutes for setting. Thus, by this new method it would appear practicable for a small vessel, carrying 4 or 5 men, to fish 100 or more baskets of gear a day.

DEFECTS: It should be emphasized, however, that the method has only been tried experimentally and that additional testing and experience with the gear are necessary to insure satisfactory commercial application. Only a few defects in design have been noted so far, but these appear to be minor. One anticipated difficulty, that of fouling of the mainline in the tub during setting operations, failed to materialize. Indeed, less fouling by the tub method was experienced than when assembling and setting baskets by hand.

The most serious drawback noted so far is the excessive wear and tear on the mainline at the bridles caused by the impact of the "D" rings on rollers and longline hauler during hauling operations. In an effort to overcome this, the rollers have been made larger in diameter and the "D" rings have been reduced in size. To eliminate the difficulty altogether, a method of joining the droppers to the mainline by a system which swivels as freely as the "D" ring method, but which has less bulk, is needed.

Another defect of the present gear is that the knots which join the mainline sections abrade rapidly by passage through the haulers, so that the line at the knots needs recutting and splicing before the mainline itself is worn out.

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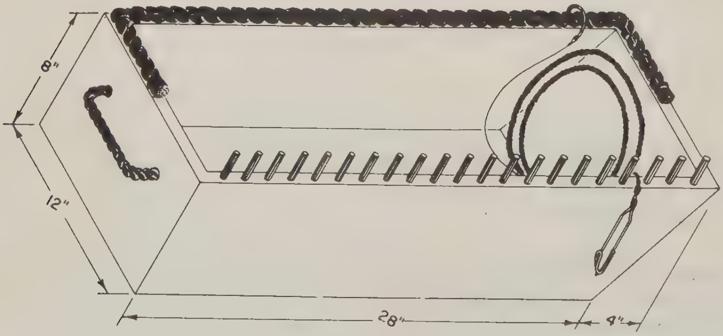

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DESCRIPTION AND DISTRIBUTION OF LARVAE OF FOUR SPECIES OF TUNA IN CENTRAL PACIFIC WATERS

BY WALTER M. MATSUMOTO

FISHERY BULLETIN 128
From Fishery Bulletin of the Fish and Wildlife Service
VOLUME 58

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR, Fred A. Seaton, *Secretary*
FISH AND WILDLIFE SERVICE, Arnie J. Suomela, *Commissioner*

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By Walter M. Matsumoto

March 3, 1849

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ABSTRACT

The larvae of four species of tuna—yellowfin (*Neothunnus macropterus*), skipjack (*Katsuwonus pelamis*), little tunny (*Euthynnus yaito*), and frigate mackerel (*Auxis thazard*)—are described in detail. Diagnostic characters are given to aid in the identification of the species.

The geographical and seasonal distributions of tuna larvae in equatorial waters from 1950 to 1952 are described. Yellowfin and skipjack larvae, which were the most abundant of the four species, were found to occur over a wide area between 23° N. and 15° S. latitude, from 120° W. to 180° longitude, the limits of the area investigated. The distribution was generally uniform over the entire area, but a slightly heavier concentration was noticed between 140° W. and 160° W. longitude from 5° S. to about 10° N. latitude. Although the geographical range has not been completely defined, the close adult-larva relationship points to a continuous transoceanic distribution along the equatorial currents. Both species appeared to be uniformly abundant throughout the year.

Nearly all the larvae were concentrated in the top 50 meters of water, with indications of a vertical, diurnal migration.

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ESCRIPTION AND DISTRIBUTION OF LARVAE OF FOUR SPECIES OF TUNA IN CENTRAL PACIFIC WATERS

By Walter M. Matsumoto, *Fishery Research Biologist*

Bureau of Commercial Fisheries

The distribution of tuna larvae in the central ıcific is only one of several facets of an investi- tion of the life history, distribution, and undance of tuna being undertaken by the ıcific Oceanic Fishery Investigations (POFI), the United States Fish and Wildlife Service. ıe purpose of the present study is to identify d describe the tuna larvae found in these waters, gain information on the location and time of awning, and to obtain another measure of the mparative magnitude of the adult populations the different species.

While it would have been logical and desirable study the early life history of the tunas, ginning with the eggs, it was not possible to so, since there were no discernible differences tween the eggs of one species of tuna and those another. All the ripe or near-ripe eggs exam- ed from known species appeared alike (all had opaque yolk mass and a distinctly noticeable droplet), and the range of egg diameter meas- ements for any one species overlapped that of e others. Consequently, no detailed work was ne on their identification.

This paper presents comparative descriptions, sed on material from zooplankton hauls, of the vae of four species of tuna: yellowfin, *Neothun- s macropterus* (Temminck and Schlegel); skip- k, *Katsuwonus pelamis* (Linnaeus); little tunny, *ıthynnus yaito* Kishinouye; and frigate mack- l, *Auxis thazard* (Lacépède). The collections e sufficiently complete to enable us to trace the veral species from early through late larval ıges. The report also contains discussions of e horizontal and vertical distribution of these vae, the diurnal variation and species composi- n of the larval catches, and estimations of the awning area and time of spawning as evidenced the development and distribution of the larvae.

The zooplankton samples from which the tuna larvae were collected were obtained from two main areas, equatorial waters and Hawaiian waters, during the years 1950 to 1952 on eight cruises of the POFI research vessel *Hugh M. Smith*. General station positions are shown in figures 1 and 2 (data on larvae collections for all the cruises are compiled in appendix tables 1 to 8, pp. 67–72). Samples were taken in 1-meter nets (*see* King and Demond, 1953, for detailed description), hauled according to two different methods. The first method was a 1-hour horizontal haul in which three nets were towed simultaneously at three different depths. The second method was a 30-minute oblique haul, a single open net being lowered to a depth of 200 meters and raised to the surface in a continuous operation.

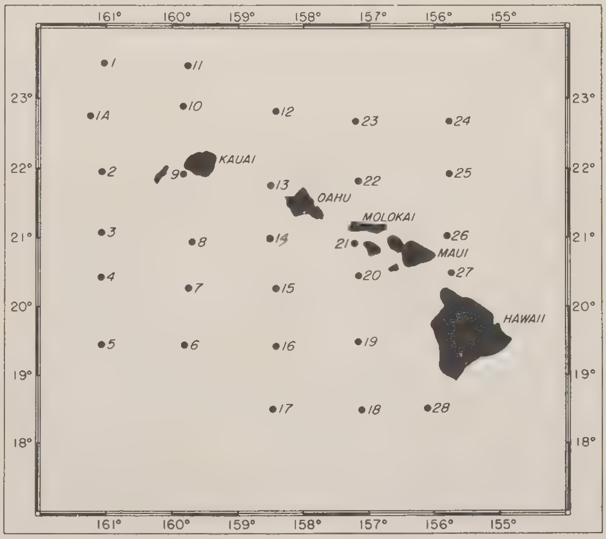

Figure 1.—Station locations of the *Hugh M. Smith* during cruise 6 in Hawaiian waters

In addition to the material collected by POFI, about 100 specimens of *E. yaito* and over 500 specimens of *A. thazard* taken in waters of the

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OTE.—Approved for publication, February 26, 1957. Fishery Bulletin

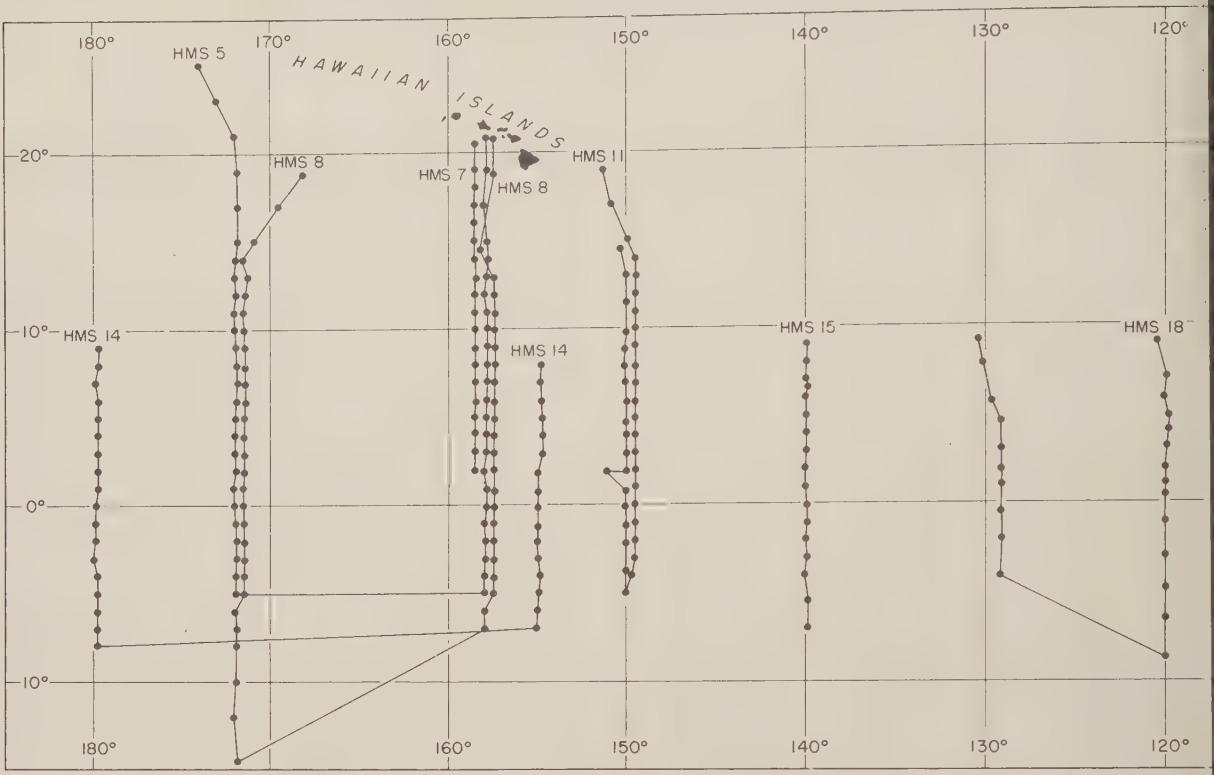

FIGURE 2.—Station locations of the *Hugh M. Smith* in equatorial waters.

East Indies during the 1928–30 *Dana* Expedition were examined.

The author wishes to thank the many POFI staff members who assisted in sorting the fish larvae from plankton samples, Wilvan Van Campen for numerous translations of literature in the Italian and Japanese languages, Tamotsu Nakata for drafting the charts in the text and for his advice on the reproduction of the drawings of tuna larvae, and the various staff members who critically reviewed the manuscript. Special thanks go to Dr. Å. Vedel Tåning, through whose kindness it was possible for us to examine the larval tunas collected during the 1928–30 *Dana* Expedition; to Dr. Milner B. Schaefer, Director of the Inter-American Tropical Tuna Commission, for the loan of juvenile *A. thazard*; to the California Division of Fish and Game for the loan of juvenile *E. lineatus*; to the Gulf Fishery Investigations for the loan of juvenile *E. alletteratus*; and to Dr. E. H. Ahlstrom, South Pacific Fishery Investigations, U. S. Fish and Wildlife Service, for his helpful criticisms and suggestions on the drawings of the larvae.

DESCRIPTION OF SPECIES

While there have been several valuable co
butions to the identification of juvenile tunas,
little has been done on the identification of
larvae. The two most complete studies to
are those by Ehrenbaum (1924) and Wade (1
Ehrenbaum examined larvae collected on
Danish oceanographical expeditions of 190
to the Mediterranean and adjacent seas.
lack of juveniles in his collections did not p
him to make positive species identifications,
although his work has been cited in this pap
a general reference, for the most part his ide
fications have not been followed. Wade stu
the larvae taken from waters around the Philip
Islands and was successful in collecting larva
well as juvenile specimens of *N. macropterus*
pelamis, and *E. yaito* (Wade 1950). His co
tions came from an area where adults of
species of Scombridae had previously been
corded [i. e., *Thunnus orientalis*, *T. germo* (=Ge
alalunga), *Parathunnus mebachi* (=*P. sibi*), *K*
noella tonggol, and *N. macropterus*]. While t
is good reason to believe that Wade's designa

f certain larvae as *N. macropterus* is valid, some oubt exists as to his identification of *E. yaito*.

Prior to Wade's work, Schaefer and Marr 1948a, 1948b) had studied larval and juvenile ages of *N. macropterus*, *K. pelamis*, *E. lineatus*, nd *A. thazard* taken off the Pacific coast of entral America. They had no difficulty in lentifying the last three species. Regarding the rst, their material came from an area where *P. bi* is relatively scarce and their larger specimens howed anatomical characters that distinguish *V. macropterus*. However, these authors admitted the possibility that the smaller specimens ere *P. mebachi* (=*P. sibi*), since identification ould not be certain until juveniles of both species ere available.

Our *N. macropterus* larvae resembled those xamined by Wade and fitted nicely into the series f juveniles collected by Schaefer and Marr. ince ripe or nearly ripe gonads have been taken om adult *P. sibi* in equatorial waters (Yuen 955), there is a possibility that some of the rvae could also be the young of *P. sibi*. While l indications seem to favor their being *N. acropterus*, final identification must wait until rvae and juveniles of *G. alalunga*, *P. sibi*, and ome of the other scombrids have been caught and lentified.

A situation somewhat comparable to that btaining for *Neothunnus-Parathunnus* also exists r the species of *Auxis* discussed here. As ointed out by Wade (1949), the Philippine and ast Indian regions have two species of this enus, *A. thazard* and *A. tapeinosoma*, these being ather easily separated as adults but much less so juveniles. Apparently, only *thazard* occurs in e Hawaiian area,[1] and Hawaiian *Auxis* larvae e accordingly referred to this species. Because e present study also includes East Indian material, the possibility exists that specimens from at area may represent two species even though all aterial examined appeared identical with the Hawaiian *thazard*. There was no great difficulty in identifying larvae of *K. pelamis* and *E. yaito*.

In this section the detailed description of the smallest recognized specimen is given first. Descriptions of larger specimens follow in size sequence, and only the more prominent characters are noted. Finally, the distinctive characters or combinations of characters by which these species can be separated are discussed. The scheme of describing each specimen in its entirety, instead of following the development of certain anatomical characters throughout the size categories, was chosen because it seemed that this method would be more convenient for the reader. All descriptions and counts of the teeth and chromatophores on the head and body, unless specified otherwise, are based on one lateral half of the body, usually the left.

The smaller specimens were still in the initial stages of development and lacked many of the characters by which the adults are identified. They were separated into species by first segregating those larvae that were similar in appearance and then arranging them in a series according to size. From each series several specimens of various sizes were stained with alizarin according to the method described by Lipman (1935). The larger specimens in these series were more than 10 millimeters fork length and already possessed sufficient adult characters to permit positive identification. The more prominent and persistent characters, other than those used in identifying the larger specimens, were examined and traced down to the smallest individual in each series. The most useful of these characters are listed in tables 4 and 5 (pp. 53, 54). The six measurements used in tables 4 and 5 are defined as follows:

1. Total length: The distance from the tip of the upper jaw to the end of the longest caudal ray when the tail is not forked, and to the end of the middle caudal ray when the tail is forked.
2. Head length: The distance from the tip of the upper jaw to the posttemporal spine when the spine is present, and to the posterior margin of the head at the level of the vertebral column when the posttemporal spine is absent.
3. Mouth length: The distance from the tip of the upper jaw to the middle of the posterior edge of the maxillary, with the mouth closed or agape, varying with the specimen.
4. Snout length: The distance from the tip of the upper jaw to the anterior edge of the orbit.
5. Diameter of orbit: The diameter of the eye socket taken parallel to the body axis.

After this paper was submitted for publication, 21 specimens of long-rseletted *Auxis*, probably *A. tapeinosoma*, were taken about 1 mile offshore om the Island of Lanai in the Hawaiian Islands, November 30, 1957, by e Fish and Wildlife Service research vessel, the *John R. Manning*. This the first record of the capture of long-corseletted *Auxis* in Hawaiian waters. asmuch as the waters around these islands have been subjected to rather tense tuna fishing since the turn of the century and a careful check has en kept of the local fish markets for a form of *Auxis* other than *thazard* for e past 8 or 9 years, we believe that the long-corseletted form occurs very rely in local waters and that its recent appearance may be due to unusual eanographic conditions. In our opinion, its discovery does not materially ange the larval identification presented here.

6. Dorsal interspace: The distance between the insertion of the first dorsal fin and the origin of the second dorsal.
7. Tooth counts: Counts given for one side only.

In general, tuna lárvae are characterized by a compact, triangular visceral mass with a short intestine that is directed ventrally at its posterior end. The entire visceral mass is located well forward in the body, the preanal distance being less than one-half the total body length on specimens up to about 9 mm. A continuous median fin membrane starts at the nape and extends completely around the caudal region to the anal opening. The myomeres, when distinct, number between 38 and 42. The head, mouth, teeth, and eyes are well developed, and prominent preopercular spines are noticeable. Pigmentation is rather sparse, most of it being concentrated over the abdominal sac, over the brain, and in the caudal region, depending on the species.

As an aid in comparing the differences between larvae of various species and at different stages of development, the following summary of the key characters is presented in advance of the detailed descriptions, together with a sketch of a typical tuna larva (fig. 3) in which is incorporated the nomenclature used in this paper.

Neothunnus macropterus

a. Complete lack of chromatophores on the trunk, except over visceral mass, until the larva approaches 14 mm. total length.
b. No chromatophores over the forebrain.
c. Heavy pigmentation on the first dorsal specimens of more than 7 mm.

Katsuwonus pelamis

a. Presence of a distinct chromatophore on the midline of the caudal region.
b. Early appearance of chromatophores over t brain in specimens of more than 7 mm length.
c. Single chromatophore on middle of mand specimens of more than 7 mm.
d. Chromatophores only along outer edge dorsal fin.

Euthynnus yaito

a. Up to 4 chromatophores along the posterior the anal fin and the first 2 or 3 anal finlet chromatophores along the dorsal margin caudal region.
b. Series of chromatophores along the ma usually extending over the anterior half.
c. Heavily pigmented first dorsal fin.
d. Chromatophore usually present at the sym of the pectoral girdle.

Auxis thazard

a. A short series of closely spaced chromatopho the middorsal, midlateral, and midventra of the caudal region.
b. Lower jaw free from pigmentation, except tip.
c. First dorsal fin relatively unpigmented, wit less chromatophores at about 12 mm. i length.
d. Chromatophore usually present at the sym of the pectoral girdle.

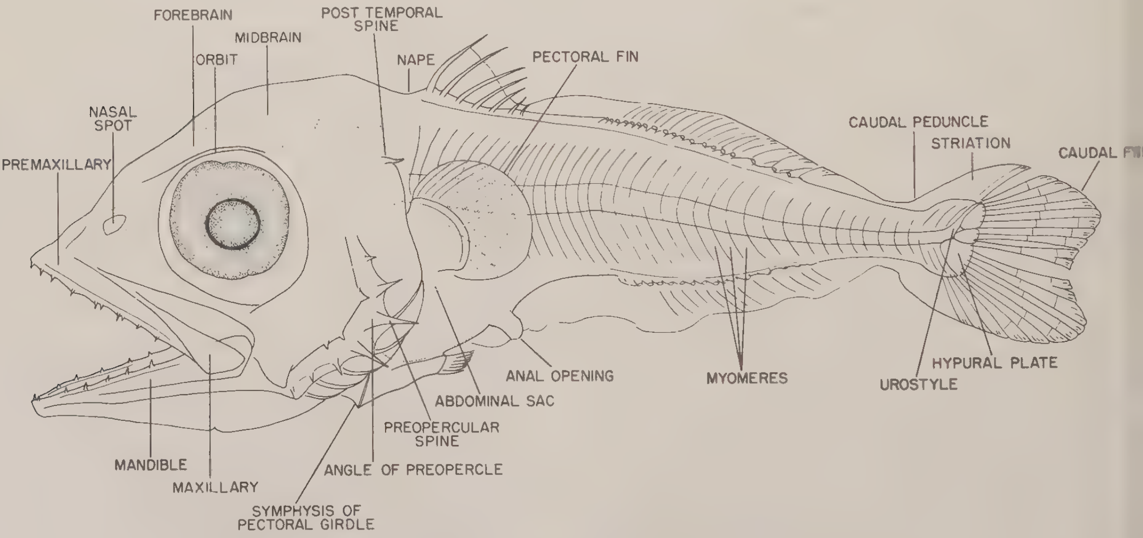

FIGURE 3.—A typical tuna larva with the nomenclature employed for various parts of the body.

YELLOWFIN (*NEOTHUNNUS MACROPTERUS*)

The description of this species is based on a tudy of 264 specimens, whose total lengths range rom less than 3.0 mm. to 14.2 mm. (table 1). Vhile the specimens less than 3.9 mm. in length ould not be identified positively, they so closely esemble the smallest larva identified as *N. macroperus* that they are included in the total.

The smallest specimen identified as *N. macroperus* measures 3.9 mm. (fig. 4) and has about 40 nyomeres. The body is evenly tapered caudally, nd the abdominal sac is roundly triangular with he anal region directed sharply downward. The nal opening is well ahead of the midlength of the ody. The snout on this specimen is slightly listorted, and no comparison of the head parts nvolving snout measurements has been atempted, although it is evident that the snout is nly slightly longer than half the diameter of the rbit. No teeth are observable on this specimen, ut other specimens of about the same length show p to 3 feeble teeth on each ramus of both jaws. hree spines project posteriorly along the edge of he preopercle, the middle one being the longest, nd 2 minute spines are present on the surface of he preopercle just anterior to the preopercular pines.

The unpaired fins are not developed, but are epresented by a continuous membrane extending rom the nape completely around the caudal end of the body to the anal opening. Membranous pectoral fins are present, but ventral fins are lacking.

ABLE 1.—*Number and size range of larval* Neothunnus macropterus *collected by the* Hugh M. Smith *in Hawaiian and equatorial waters*

[See figs. 1 and 2 for location of stations]

Cruise and station	Number of larvae	Size range (mm.)
AWAIIAN WATERS:		
Cruise 6:		
No. 1	2	5.3–6.0
No. 1A	5	4.4–6.5
No. 2	13	3.0–6.0
No. 5	2	3.5–4.5
No. 6	2	3.8–4.2
No. 7	5	5.4–8.0
No. 8	1	4.6
No. 10	12	3.3–6.1
No. 11	5	4.0–6.8
No. 13	6	4.0–5.6
No. 14	13	3.6–6.0
No. 15	7	4.0–10.2
No. 16	4	3.5–5.6
No. 18	16	3.2–7.5
No. 19	2	5.2–6.5
No. 21	8	3.6–6.5
No. 24	2	4.6–7.45
No. 25	15	3.5–5.6
No. 26	6	3.0–3.9
No. 27	6	2.5(?)–6.5
Total	132	2.5(?)–10.2
EQUATORIAL WATERS:		
Cruise 5:		
No. 8	1	3.3
No. 12	1	4.9
No. 13	2	<3.0, 4.2
No. 14	1	7.0
No. 15	1	<3.0
No. 17	1	<3.0
No. 21	2	4.4, 5.2
No. 25	1	3.8
No. 26	9	3.2–4.6
No. 39	1	6.0
No. 41	1	4.9
No. 42	2	4.9, 5.5
No. 43	1	5.5
No. 45	1	3.5
No. 48	2	3.7, 4.9
No. 51	3	3.1–5.2
Cruise 8:		
No. 9	2	6.[illegible], 7.9
No. 16	1	5.3
No. 21	1	3.0
No. 22	1	<3.0
No. 24	5	<3.0–5.6
No. 77	6	3.5–4.0
No. 78	4	<3.0–4.2
No. 79	2	4.0, 5.0
No. 82	1	14.2
No. 85	1	4.9
No. 93	1	6.2
No. 94	1	4.7
No. 97	1	5.2
No. 101	1	3.7
Cruise 11:		
No. 4	2	<3.0, 4.8
No. 6	2	5.3
No. 8	4	3.1–8.0
No. 9	4	3.2–5.6
No. 10	2	3.5, 3.7
No. 11	7	<3.0–6.6
No. 12	2	5.2, 6.6
No. 22	3	3.3–7.1
No. 23	1	3.0
No. 33	1	6.0
No. 35	1	4.0
No. 36	1	5.9
No. 37	2	4.5, 4.6
No. 40	3	<3.0–3.8
No. 42	1	3.8
No. 46	4	3.0–3.6
Cruise 14:		
No. 12	1	5.0
No. 14	1	5.0
No. 19	3	4.0–4.1
No. 20	1	7.1
No. 21	2	3.7, 4.1
No. 22	1	3.7
No. 30	4	3.8–6.4
No. 31	2	5.7, 7.8
No. 32	3	4.6–7.7
Cruise 15:		
No. 5	4	<3.0–6.0
No. 6	2	5.0, 8.1
No. 7	1	3.0
No. 14	1	4.5
No. 15	1	3.2
No. 16	1	4.1
Cruise 18:		
No. 4	2	3.0, 3.2
No. 5	2	3.1, 3.2
No. 6	1	3.2
No. 8	1	4.6
Total	132	<3.0–14.2

Head pigmentation is rather sparse, with only about 4 very small, scattered chromatophores over the membrane covering the brain and 2 internal

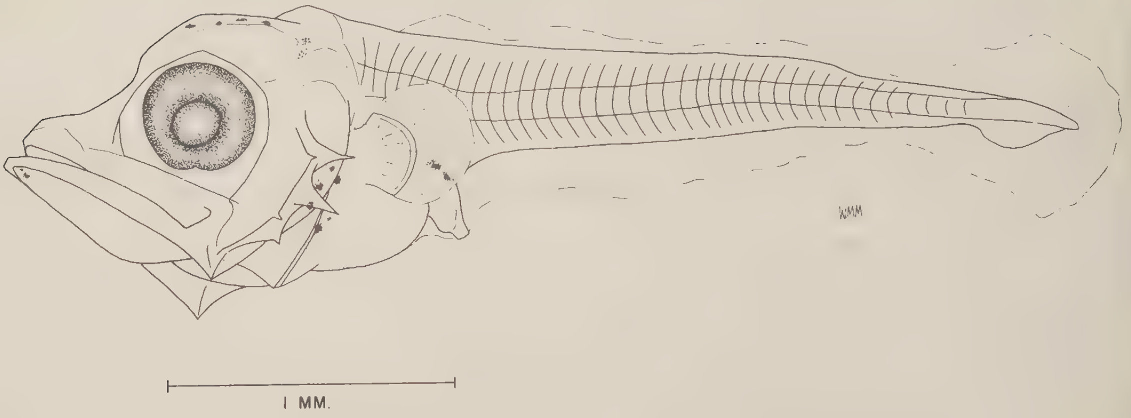

FIGURE 4.—*Neothunnus macropterus*, 3.9 mm. total length.

chromatophores along the posterior margin of the brain. Several large chromatophores are present over the anterior and posterior regions of the abdominal sac, but the rest of the body is free of pigmentation.

A specimen of 4.75 mm. has the same general appearance of the preceding stage, with 39 or 40 myomeres, but the body has deepened slightly. The teeth have increased to 5 on the upper jaw, but the 3 remain on the lower jaw. There is a slightly depressed, ovate, nasal spot on the snout which represents the future nostrils. The preopercular spines have increased to 4: 2 long spines at the angle and 2 small spines on the horizontal edge. There is no change in pigmentation, and the pelvic fins are just emerging as minute fleshy outgrowths from the ventral outline of the body beneath the abdominal sac.

Certain changes are evident in a 5.5-mm. specimen (fig. 5). The head appears slightly larger, 36.8 percent of the total length, and snout, which is two-thirds the diameter of the or is bluntly pointed. The mouth represents c 60.1 percent of the head length and all the te 8 on the upper jaw and about 4 on the lower j are small and feeble. Six preopercular spines visible: 1 small spine on the vertical edge; 3 lon spines at the angle, the middle one being longest; and 2 short spines on the horizontal e

The unpaired fins are still represented by a tinuous membrane, which has degenerated in region of the future first dorsal fin and app slightly heavier there. The membrane also sh signs of degeneration in the region of the ca peduncle, and about 10 incomplete rays noticeable in the caudal fin. The pelvic fins quite evident although they are still rudiment

The tips of both jaws bear several small ch matophores, and there are about 14 large ch matophores over the midbrain, although th

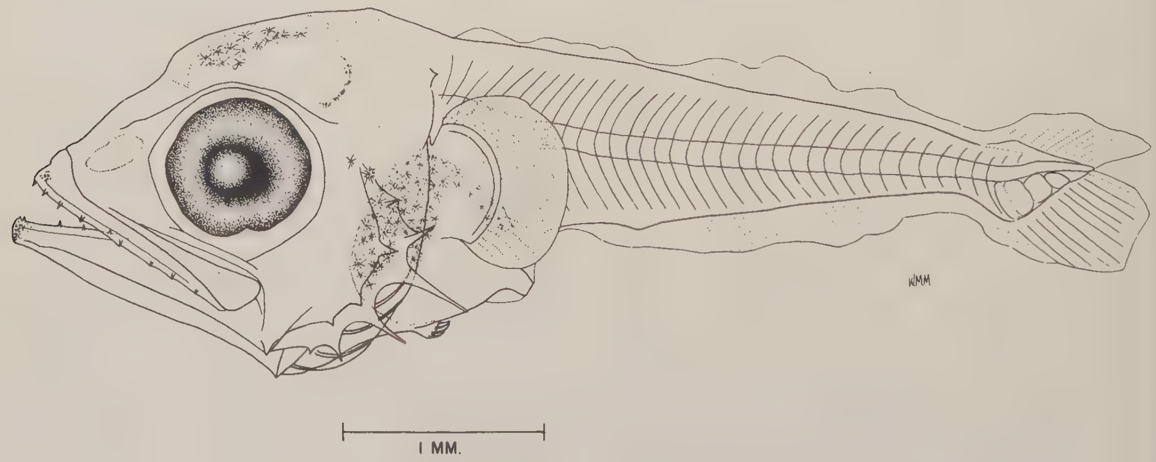

FIGURE 5.—*Neothunnus macropterus*, 5.5 mm. total length.

xtend only over half of the brain area. A band f dark pigmentation lies along the posterior nargin of the brain, and the 2 dermal chromato- hores on the side of the head near the dorsal end f the preopercle make up the remainder of the igmentation on the head. The dorsal half of ne abdominal sac bears numerous large chromato- hores, while the rest of the body is unpigmented.

Except for the appearance of 4 short spines in ne first dorsal fin, about 12 rays in the caudal fin, nd the formation of a very small spine near the osttemporal region, the specimen at 6.4 mm. fig. 6) remains relatively the same in appearance s the previous one. There is a single, faint hromatophore on the third interradial membrane f the first dorsal fin, and the fin membrane here as degenerated to the height of the spines. The nembrane is still high over the rest of the body.

At 7.15 mm. (fig. 7), the anal opening is closer to the midpoint of the body length. The snout is slightly longer, but is still not quite as long as the diameter of the orbit, and the nasal spot is beginning to constrict in the middle. The mouth is not very large and represents 62.1 percent of the head length. There are 10 or 11 small teeth on the maxillary and 6 or 7 similar teeth on the mandible.

The most noticeable development here is in the first dorsal fin, which bears 7 strong spines, the first 5 of them very long. About 19 rays are present in the caudal fin, which is just beginning to fork. The pelvic fins are only slightly larger than in the previous specimen.

There is an increase in the pigmentation over the brain, at the tips of both jaws, and over the abdominal sac. The band of pigment along the

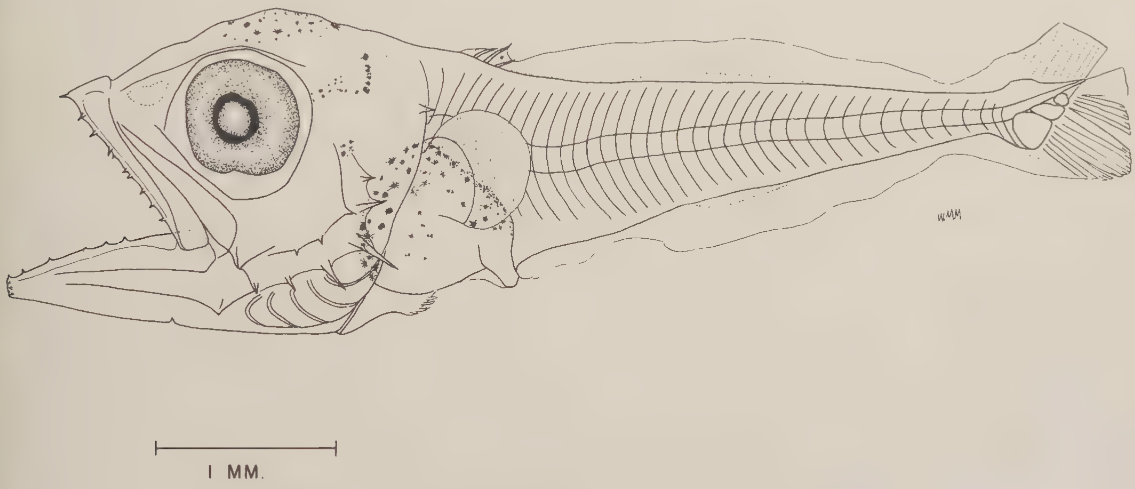

FIGURE 6.—*Neothunnus macropterus*, 6.4 mm. total length.

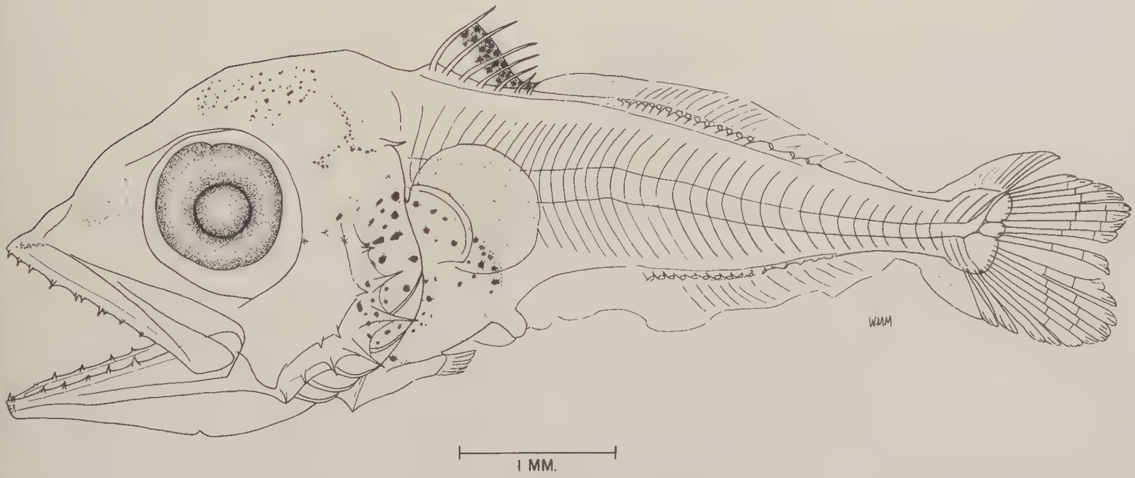

FIGURE 7.—*Neothunnus macropterus*, 7.15 mm. total length.

posteroventral margin of the brain and the chromatophores near the dorsal end of the preopercle have increased in number and are most noticeable. Two chromatophores are present near the posterior edge of the orbit, and the darkly pigmented distal half of the interradial membrane of the first dorsal fin is rather prominent.

Some interesting development is noted in a stained specimen of 7.45 mm. While many of the dermal bony structures have ossified, the anterior vertebrae are just in the process of ossification. The first six vertebrae appear as "rings" and each of them has a very large, complete neural arch. On succeeding vertebrae the areas of ossification diminish in size until only the bases of the neural and haemal arches and their corresponding spines are evident at about the 14th vertebra. Posteriorly, only the urostyle is completely ossified and the hypural plate is just beginning to ossify.

A 7.95-mm. specimen is shown in figure 8. The general shape of the body remains the same as in the preceding specimen. The more obvious developments are the almost complete separation of the nasal openings, the deeper fork of the caudal fin, and the darker and larger area of pigmentation on the first dorsal fin, which is now almost completely pigmented, except for a narrow strip near its base. About 9 to 10 teeth are present on each jaw and 3 teeth are noticeable on the palatine bone.

While both the dorsal and anal fin rays are represented only by striations, there are 13+13 caudal rays. The pelvic fins, although complete with 1 spine and 5 rays, are very short. rays of the pectoral fins are not distinct appear only as striations.

In a 9.2-mm. specimen there is no appar change in the head size, which is 37.9 percen the total length of the body (fig. 9). The opening is at the midpoint of the body len and the snout appears longer, its length be about the same as or slightly greater than diameter of the orbit. The nares are separ and both upper and lower jaws bear 12 te while the palatine bone has about 4 very sm teeth. Seven preopercular spines are discerni 2 spines on the vertical edge, 2 spines at the an and 3 spines on the horizontal edge.

The first dorsal fin has 10 spines and a sligh convex outline. The rays of the second do fin are not clearly defined and no accurate co could be made. There appear to be about 6 c dorsal "finlets" and the anal fin has about rays and 7 finlets, though the finlets are not co pletely formed and none of them is definit separated from the others. The caudal fin 14+15 rays, and the depth of the fork is ab one-third the length of the longest caudal fin r The pelvic fins have the full adult complement spines and rays, the longest of which are ne as long as the longest spine of the first dorsal

A stained specimen of 10.2 mm. shows 13 co pletely ossified vertebrae, and 13 more which only partly ossified. The first haemapophy appears on the 8th vertebra, and closed haem arches are present only on the 11th, 12th, 13th vertebrae. On the 12-mm., stained spe

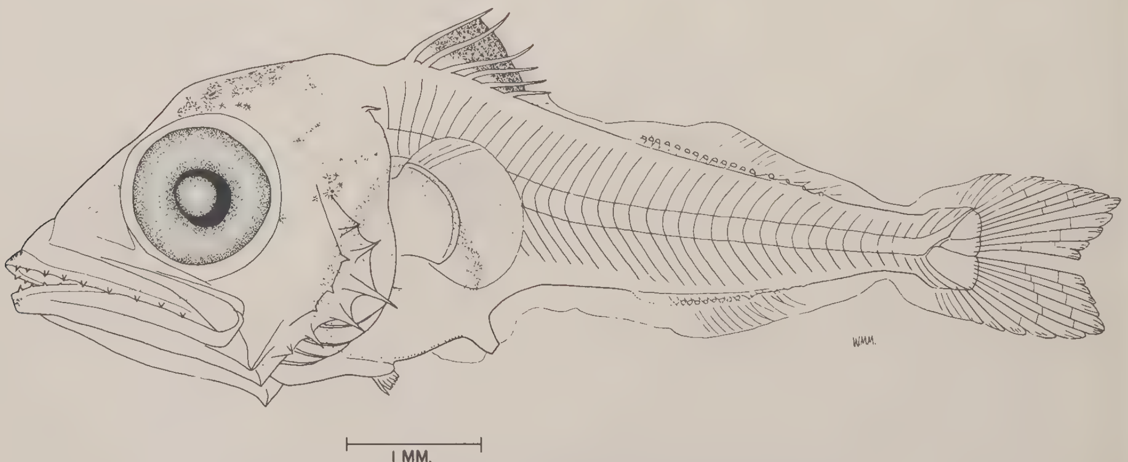

FIGURE 8.—*Neothunnus macropterus*, 7.95 mm. total length.

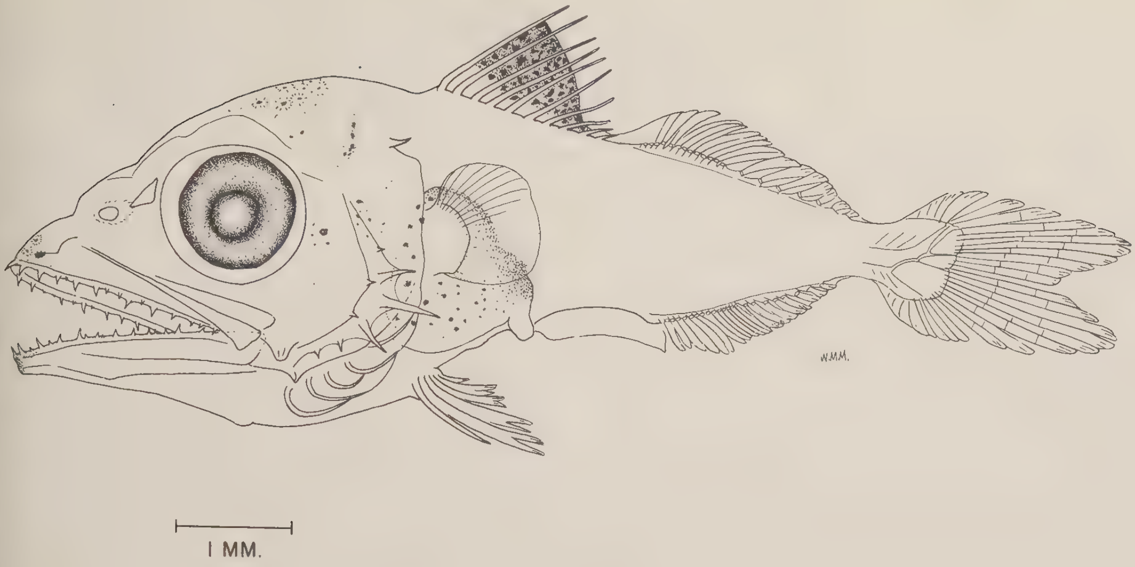

FIGURE 9.—*Neothunnus macropterus*, 9.2 mm. total length.

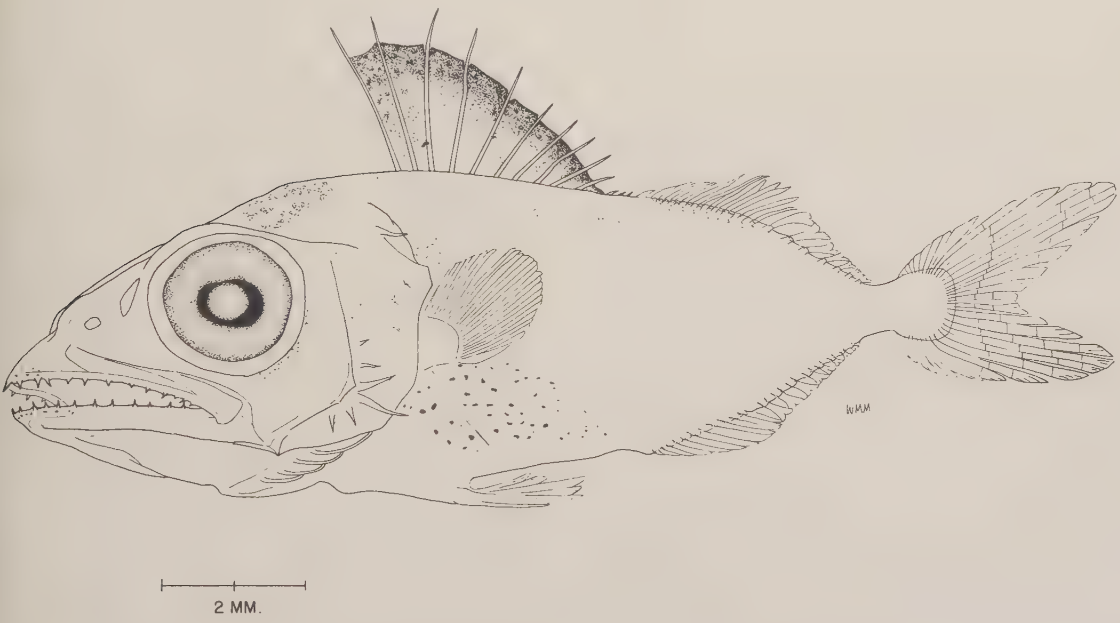

FIGURE 10.—*Neothunnus macropterus*, 14.25 mm. total length.

n all of the vertebrae are ossified, and they
mber 18 precaudals and 20 caudals, including
urostyle. The first few vertebrae are begin-
g to assume the hourglass shape of the adult
trum. The haemal arches are narrow, none
them being as wide as the diameter of the
trum at this stage of development.

At 14.25 mm. (fig. 10) the body is much deeper,
ecially near the insertions of the second dorsal
d anal fins. The triangular abdominal sac is large and elongate, and the anal opening is just anterior to the insertion of the anal fin.

The head, which is 39.7 percent of the total body length, appears very large, and the length of the snout is equal to the diameter of the orbit. The nares are well separated, the round, anterior naris being about one-third the size of the nearly elliptical, posterior one. About 13 or 14 teeth are noticeable on both the upper and lower jaws in the unstained specimen. Six preopercular spines are visible, but only the 2 longest ones at the angle still project free from the preopercular bone.

The first dorsal fin is composed of 14 spines and the fin outline appears slightly convex. Both the second dorsal and anal fins consist of 15 rays and 8 finlets. There are about 18+19 rays in the caudal fin, but those near the anterior edges are not clear enough to be counted accurately. The pelvic fin is very large and is almost as long as the pectoral fin, which now bears about 30 rays.

Pigmentation is beginning to resemble that of juveniles. The large chromatophores over the brain still extend over a relatively small area, but numerous, very minute chromatophores appear over the posterior part of the head and extend posteriorly in a band to a point beneath the insertion of the second dorsal fin. There is a patch of similar pigmentation immediately behind the opercle and dorsal to the pectoral-fin insertion. Small chromatophores also line the posteroventral margin of the orbit, while 5 to 6 large chromatophores are present on the surface of the opercle posterior to the eye. Pigmentation over the abdominal sac remains unchanged, while the first dorsal fin is now completely pigmented. A faint line of chromatophores is present along the bases of the first and second dorsal fins, extending posteriorly to about the second dorsal finlet. The rest of the body has no pigmentation.

SKIPJACK (*KATSUWONUS PELAMIS*)

A total of 476 specimens of *K. pelamis* measuring from 2.3 mm. to 20.1 mm. was sorted from plankton collections and examined (table 2). Also studied were 34 specimens from 20.0 mm. to 43.0 mm. collected with dip net at night-light stations in Kingman Reef lagoon in May 1951.

The smallest specimen that could be identified positively as *K. pelamis* measures 3.7 mm. in length (fig. 11); this specimen appears somewhat distorted in preservative. The body is elongate with both the dorsal and ventral outlines tapering evenly to the caudal end. The abdominal sac is roundly triangular in shape with the anal opening slightly anterior to the midpoint of the total length of the body.

Although the snouts on other specimens of comparable size are rather pointed, this is not evident here, probably because of distortion. The upper

TABLE 2.—*Number and size range of larval* Katsuw pelamis *collected by the* Hugh M. Smith *in Hawaiia equatorial waters*

[See figs. 1 and 2 for locations of stations]

Cruise and station	Number of larvae	Size (mm
HAWAIIAN WATERS:		
Cruise 6:		
No. 1	1	
No. 1A	11	
No. 2	4	
No. 4	10	
No. 5	14	
No. 7	4	
No. 8	9	
No. 10	29	2. 5
No. 11	9	
No. 13	12	
No. 15	13	
No. 16	6	
No. 18	27	
No. 19	3	9.
No. 20	2	3
No. 22	2	4.
No. 24	3	
No. 25	1	
No. 27	4	
Total	164	2.
EQUATORIAL WATERS:		
Cruise 5:		
No. 2	1	
No. 4	3	
No. 11	3	4
No. 14	4	
No. 16	2	9.
No. 19	1	
No. 21	1	
No. 22	8	
No. 23	24	
No. 25	17	
No. 26	2	
No. 32	1	
No. 35	1	
No. 36	6	
No. 37	6	
No. 38	1	
No. 42	1	
No. 43	2	Di.
No. 45	4	
No. 46	1	
No. 51	2	
Cruise 8:		
No. 11	3	
No. 20	1	
No. 25	2	
No. 77	9	
No. 78	2	
No. 79	5	
No. 80	2	
No. 81	2	
No. 84	4	
No. 85	1	
No. 87	1	
No. 88	1	
No. 89	1	
No. 90	8	
No. 91	3	
No. 93	1	
No. 94	1	
No. 95	2	
Cruise 11:		
No. 1	1	
No. 6	1	
No. 9	1	
No. 10	1	
No. 11	6	2.
No. 12	1	
No. 22	2	3.
No. 23	1	
No. 24	2	5. 5
No. 26	2	
No. 27	3	3
No. 29	21	3
No. 31	7	3
No. 33	1	
No. 36	1	
No. 37	3	3
No. 38	1	
No. 41	1	
No. 42	1	
No. 43	1	

ABLE 2.—*Number and size range of larval* Katsuwonus pelamis *collected by the* Hugh M. Smith *in Hawaiian and equatorial waters*—(Continued)

[See figs. 1 and 2 for location of stations]

Cruise and station	Number of larvae	Size range (mm.)
QUATORIAL WATERS—Continued		
Cruise 14:		
No. 2	9	3.5–6.0
No. 4	1	3.1
No. 7	1	3.3
No. 8	1	3.0
No. 9	14	3.4–10.3
No. 10	2	5.0, 7.0
No. 12	4	5.0–9.4
No. 14	3	2.3–6.0
No. 17	2	4.2, 9.0
No. 18	3	3.5–5.6
No. 20	7	4.0–6.2
No. 21	8	4.0–4.6
No. 22	2	3.5, 4.5
No. 24	1	3.7
No. 25	2	3.0
No. 29	4	3.2–5.0
No. 30	4	3.5–6.5
No. 32	1	4.0
Cruise 15:		
No. 6	7	3.2–6.5
No. 7	10	3.2–7.5
No. 8	10	3.1–5.0
No. 9	8	2.7–5.9
No. 10	1	19.0
No. 14	3	3.2–4.2
No. 15	1	3.6
No. 17	1	4.5
Cruise 18:		
No. 5	1	4.5
No. 6	1	10.1
No. 21	1	5.0+(distorted).
No. 24	1	5.4
Total	312	2.3–20.1

nd lower jaws contain 4 and 6 teeth, respectively, nd there are 3 spines along the edge of the prepercle, the middle one being the longest. The ectoral fins are present, but are represented only y a thin membrane, while the pelvic fins are comletely absent. The median fins are represented y a continuous membrane which begins at the ape and continues around the caudal end to the anal opening. No fin rays are developed, but a few faint striations can be seen in the caudal region.

Most of the pigmentation is subcutaneous. About 10 small chromatophores are scattered over a fairly large portion of the membrane covering the midbrain. The dorsal edge of the abdominal sac is pigmented with very small chromatophores, while a very large one is evident on the anterior edge. A single chromatophore is present along the midventral line at about the 34th myomere. In all specimens examined the presence of this chromatophore is extremely consistent, although sometimes 2 or 3 replace the usual 1. The only dermal pigmentation on this specimen occurs at the tip of the lower jaw, where 2 to 3 small chromatophores are noticeable.

A specimen of 5.35 mm. (fig. 12) shows some advances in development. The head, representing 38.7 percent of the total length, is very large in relation to the rest of the body, and the sharply pointed snout is slightly longer than the diameter of the orbit. The length of the mouth is equivalent to 71.6 percent of the head length, and is much larger than that of *N. macropterus* of a comparable size. The teeth, 13 on the upper and 11 on the lower jaw, are well developed, and 6 spines are present along the edge of the preopercle. The pigmentation is now more extensive and covers more than half the area of the midbrain. The pelvic fins are seen only as small buds. No vertebrae are formed as yet and myomeres are only faintly visible. They number either 41 or 42.

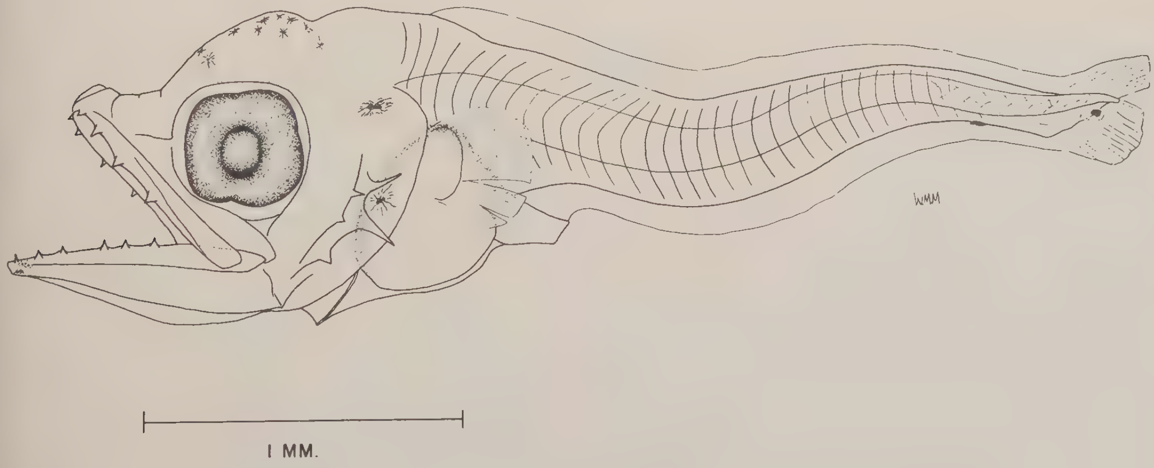

FIGURE 11.—*Katsuwonus pelamis*, 3.7 mm. total length.

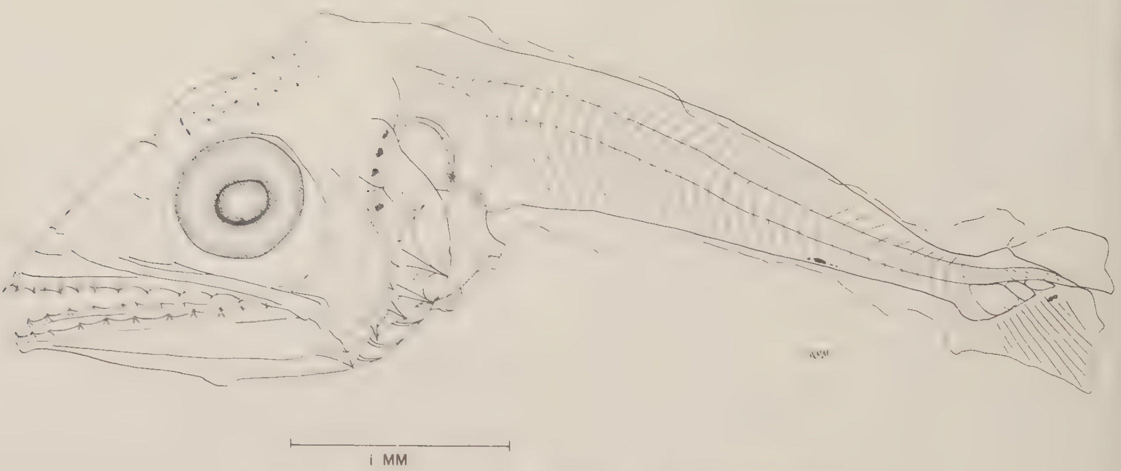

FIGURE 12.—*Katsuwonus pelamis*, 5.35 mm. total length.

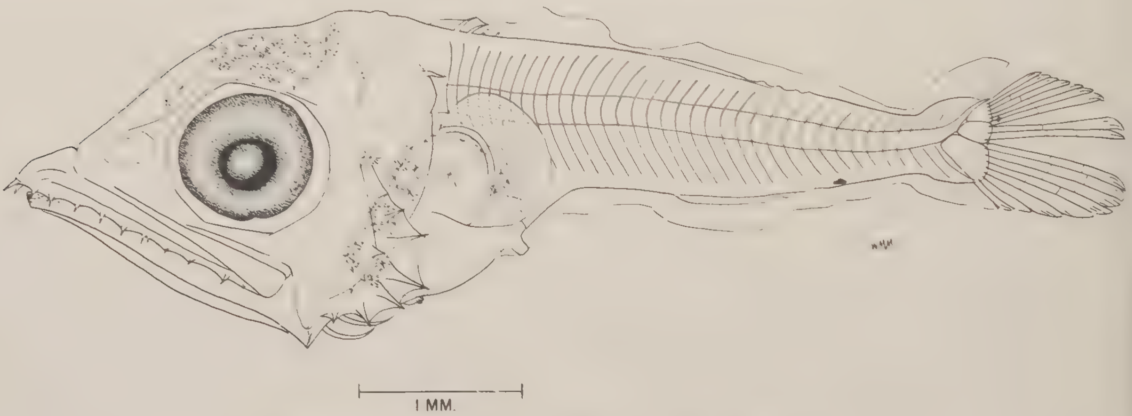

FIGURE 13.—*Katsuwonus pelamis*, 6.7 mm. total length.

The beginnings of the hypural plates are present, and the urostyle has developed and is turned upward.

The greatest change in a 6.7-mm. specimen (fig. 13) is in the first dorsal fin, where 4 spines have developed, the first 2 being very distinct. The only fin showing further development is the caudal, which now contains 18 rays. The urostyle is turned upward and the hypural plates are in a more terminal position. These bones are not yet ossified and do not take a stain.

The number of chromatophores over the midbrain has increased to about 33, and 2 closely set chromatophores are present over the forebrain, well ahead of the main, pigmented area. One or 2 large, dermal chromatophores appear on the side of the head near the dorsal end of the preopercle, while the pigmentation on the abdominal sac shows only a slight increase. No change is shown by the single chromatophore on the ventral line of the caudal region, or in th myomeres.

At 7.1 mm. (fig. 14), the body is very deeper and the head, composing 43.2 percen the total length of the body, is still large. snout length is almost equal to the diamete the orbit. Eight short spines are present in first dorsal fin, and the fin rays and finlets of second dorsal and anal fins are beginning to velop. These appear only as striations in membrane and cannot be counted accurat The membrane between the first and second dc fins is beginning to degenerate, and there about 12+11 rays in the caudal fin, the poste edge of which has just begun to fork.

Pigmentation over the brain is similar to on the previous specimen, but it extends almost the entire midbrain area. Two additi chromatophores appear: a small one on the lower jaw, at about one-fourth of the jaw length posterior to the tip, and another on the first dorsal in at the outer edge of the second interradial membrane.

Several noticeable changes have taken place by the time the species has reached a length of 8.75 mm. (fig. 15). The anal opening is now slightly posterior to the midpoint of the total length of the body. The head is still large, 41.3 percent of the total length, and the snout, which is nearly equal to the diameter of the orbit, is sharply pointed. The growth across the nasal opening is complete, thus forming 2 openings. The mouth is large and represents 66.0 percent of the head length. There are 16 to 18 teeth on both jaws and about 5 on the palatine bone.

Eight or 9 spines are present in the first dorsal fin and, while their number does not differ appreciably from that in the 7.1-mm. specimen, they are nearly twice as long. There are about 10 rays and 6 or 7 finlets in both the second dorsal and anal fins. The pelvic fins are well developed, with 1 spine and 5 rays, while the pectoral fins are only striated.

Changes in pigmentation consist of the appearance of a few more chromatophores over various parts of the body. Several dark chromatophores are scattered on the tip of the snout, and the chromatophore on the lower jaw has moved back

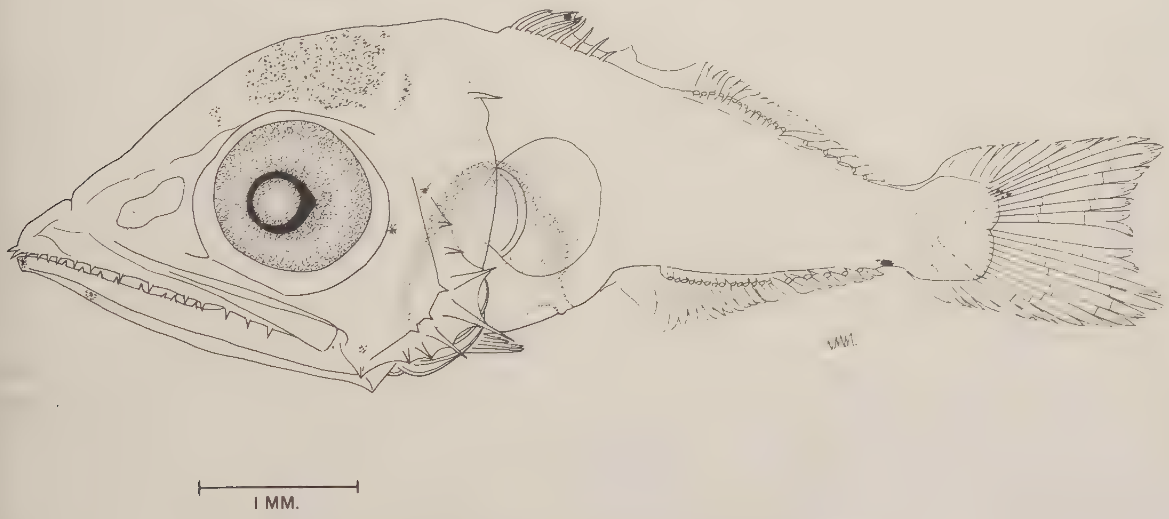

FIGURE 14.—*Katsuwonus pelamis*, 7.1 mm. total length.

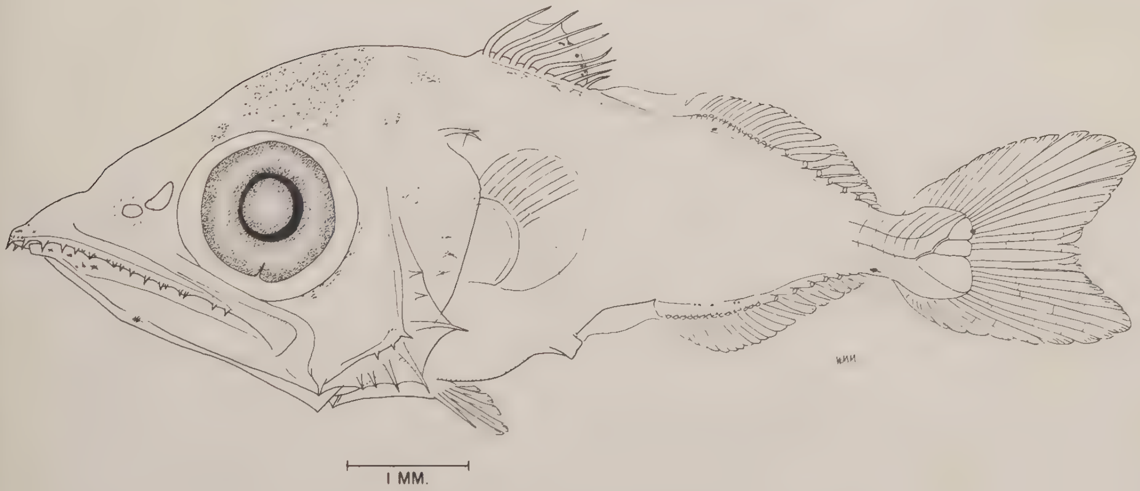

FIGURE 15.—*Katsuwonus pelamis*, 8.75 mm. total length.

to about one-half the length of the mandible. The posteroventral edge of the orbit is lined with about 10 small chromatophores, and about 6 fairly large, faint chromatophores are present on the preopercular surface posterior to the eye. Three or 4 small chromatophores also are noticeable in the posttemporal region, while 6 to 8 chromatophores appear along the base of the first dorsal fin and 1 near the second dorsal fin insertion. The outer edges of the 3d through the 6th interradial membranes of the first dorsal fin are pigmented with about 6 large chromatophores. Three chromatophores are also present along the base of the anal fin.

Rapid vertebral development has occurred between the 8.0-mm. and the 8.8-mm. specimens, both of which were stained. Only the urostyle is ossified on the smaller specimen, while the larger one shows complete ossification of the urostyle and the first 11 vertebrae. The first haemapophysis occurs on the 9th vertebra and the first closed haemal arch on the 11th.

Very definite changes are seen in a 10.9-mm. specimen (fig. 16). The abdominal sac is still roughly triangular, but the anal opening has moved back toward the anal-fin insertion. The nostrils are farther apart and, while the posterior one is still elliptical in shape, the anterior one is now smaller and more circular.

There are 9 preopercular spines: 4 small spines on the horizontal edge, 3 short spines on the vertical edge, and 2 very long spines at the angle. All of these, with the exception of the 2 long ones at the angle, are completely overgrown by the preopercular bone.

Fin development shows the greatest chan
There are 13 definite spines in the first do
about 15 rays plus 8 finlets in the second do
and about 14 rays plus 7 finlets in the anal
However, differentiation between the last fin
and the first finlet is not clearly defined.
caudal fin rays number 16+16, and the pelvic
show the full complement of 1 spine and 5 ray

There is an increase in the number of chrom
phores over the brain, at the tips of both j
and along the posteroventral margin of the o
The area posterior to the brain between the p
temporal spine and the dorsal edge of the b
bears numerous small chromatophores, which
tend backward along the dorsal margin of the b
and gradually disappear near the base of the
dorsal finlet. Four small chromatophores are
sent along the base of the anal fin, and the sim
dark chromatophore still persists on the ven
midline of the caudal peduncle. Six large cl
matophores appear on the midlateral line of
body between verticals through the second do
insertion and the first dorsal finlet.

The vertebral count on a stained specime
9.85 mm. is 20 precaudal plus 21 caudal verteb
including the urostyle. All of the vertebrae
completely ossified, but none of the centra sh
the typical hourglass shape of the adult. The
haemapophysis is on the 9th vertebra, and
first closed haemal arch is on the 11th. There
no inferior foramina along the vertebral colum
this stage of development.

At 14.5 mm. (fig. 17), the body does not ap
to be quite as deep as in the smaller specimens
the head is smaller in relation to the body (

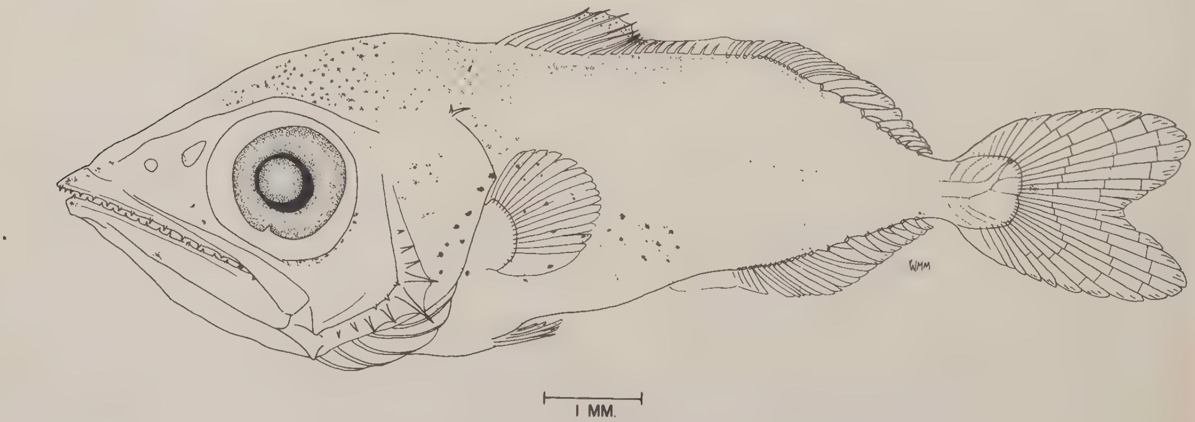

FIGURE 16.—*Katsuwonus pelamis*, 10.9 mm. total length.

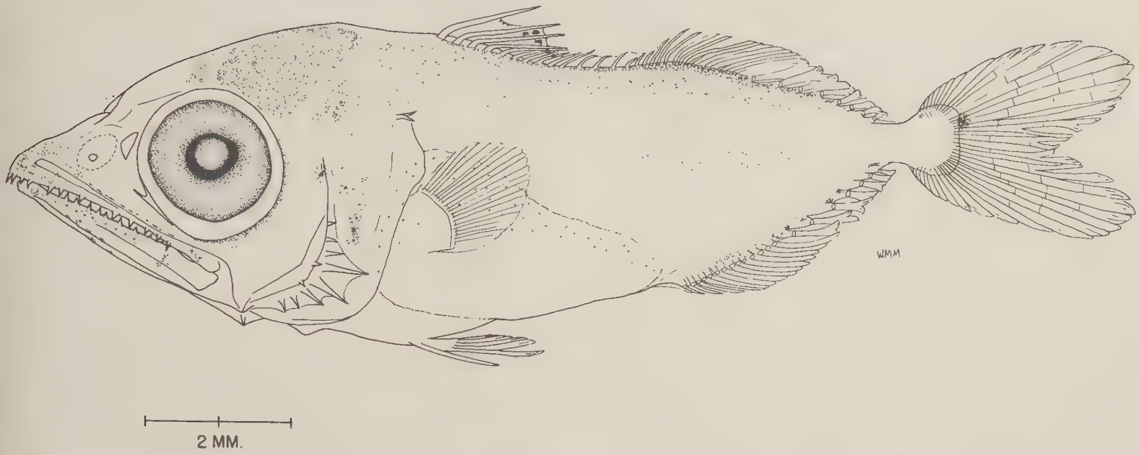

FIGURE 17.—*Katsuwonus pelamis*, 14.5 mm. total length.

ercent of total length) than in the previous speci- iens. The abdominal sac is elongate, and the nal opening is very close to the insertion of the nal fin.

The nostrils are further differentiated, with the ound, anterior nostril about one-fifth the size of he triangular, posterior one. The mouth is rela- vely smaller, 57.9 percent of the head length, and ears about 15 teeth on the upper jaw and about 7 teeth on the lower jaw. Six teeth are also vident on the palatine bone.

The dorsal fin has 16 spines, 15 rays, and 8 nlets, and the first dorsal has assumed the charac- ristic concave outline of the adult fin. The elvic fins are very well developed and appear to e a little more posterior than on previous speci- ens. The pectoral fins have 20 rays, while the ell-forked caudal has 22+22 rays.

There are 20 precaudal and 21 caudal vertebrae. he first haemapophysis appears on the 8th or 9th ertebra, while the first completely closed haemal ch is on the 12th. Neither the inferior foramina or the large haemal arches, which form what ishinouye (1923) calls the "trellis" and Godsil nd Byers (1944) call a "complex basket work," e developed.

Pigmentation is more extensive in all areas escribed on previous specimens. The chroma- phores over the snout have increased in number nd line the entire length of the upper jaw. imilarly, two-thirds of the length of the lower w is also lined with chromatophores. The idbrain is completely covered with dark, very- osely set chromatophores, and the small patches over the forebrain and on the side of the head immediately posterior to the brain are more intense. The 7 or 8 chromatophores on the surface of the opercle, posterior to the eye, are very large and noticeable. The pigmentation along the posteroventral margin of the orbit is also more intense and extends along nearly half the circumference. Dorsally, the band of chromatophores on the caudal trunk is much wider. It tapers posteriorly and finally terminates near the base of the 5th dorsal finlet. Six or seven darkly pigmented spots are present on the outer edge of the interradial membranes of the first dorsal fin between the 2d and 6th spines. The base of the anal fin is lined with tiny chromatophores, and 3 fairly large chromatophores are present at the bases of the first 3 anal finlets. A band of small chromatophores is also present on the midlateral line beginning at a vertical through the second dorsal insertion and extending to a vertical through the base of the 4th dorsal finlet. The single, large chromatophore at the midventral line of the caudal peduncle still persists, as do the large chromatophores over the dorsal half of the abdominal sac.

A 20.0-mm. specimen, which is not illustrated, was taken at a night-light station in Kingman Reef lagoon, and this individual already shows the characteristic appearance of the juvenile form. The body is narrow and long, with the greatest depth located at a vertical through the pelvic-fin insertion and equal to about one-fourth the total length. The head length is about one-third the total length, and the snout still retains the rather sharply pointed profile. Except for the increase in pigmentation over the body, this specimen resembles the 14.5-mm. one very closely. A stained specimen of a similar size shows the dorsal fins with 16 spines, 15 rays, and 8 finlets, and the anal fin with 15 rays and 7 finlets. The pectoral fins consist of 20 or 21 rays and the caudal fin has 22+22 rays. The vertebrae number 20 precaudals and 21 caudals, with the first haemapophysis on the 9th and the first closed haemal arch on the 11th vertebra. The inferior foramina are just beginning to form on the 13th through the 22d vertebrae, but they are not yet completely closed.

This description agrees very closely with Schaefer and Marr's (1948b) 21-mm. specimen and also with Kishinouye's (1926) 26-mm. specimen. Examination of other stained specimens (22 mm., 27 mm., 33 mm., and 49 mm.) shows that many of the adult complement of meristic characters have appeared by the time the species has reached 27 mm. in length. The inferior foramina are completely closed on the 14th through the 33d and 34th vertebrae in the 27- and 49-mm. specimens, respectively. The foramina are slightly increased in size on the latter specimen, but the trellis is still not evident.

LITTLE TUNNY (*EUTHYNNUS YAITO*)

No specimen of *E. yaito* was recognized in our collections. The following description is based on more than 100 larvae, believed to be *Euthynnus*, which were taken in East Indian waters during the *Dana* Expedition of 1928–30. The largest specimen (12.25 mm.) has 39 vertebrae and seems identical in external appearance to two *E. lineatus* (21 and 26 mm.) taken by California Department of Fish and Game f the waters off Costa Rica and also to the juve of 20 *E. alletteratus* (25 to 55 mm.) taken b U. S. Fish and Wildlife Service, Gulf Fish Investigations, from the Gulf of Mexico. the larva is definitely not *E. lineatus* can be from the vertebral count, for *E. lineatus* nor has only 37 vertebrae. Positive identificat either as *E. yaito* or *E. alletteratus*, woul relatively easy if the gill rakers were fully veloped. Since they are not, the larva was de nated as *E. yaito* because this species occur the central and western Pacific Ocean, whil *alletteratus* is found in the Atlantic Ocean and Mediterranean Sea.

The smallest specimen identified as *E. y* measures 4.6 mm. in total length (fig. 18). head length is moderate (33.9 percent of the t length) and there are 40 myomeres. The ab minal sac is nearly triangular in shape, as in two previous species.

The mouth, representing 71.9 percent of head length, is fairly large and contains 12 a teeth on the upper and lower jaws, respecti The snout is comparable to that of *K. pelam* similar size, and the distance from its tip to anterior edge of the orbit is almost equal to diameter of the orbit. There are 3 long sp along the posterior edges of the preopercle, one at the angle being the longest.

Most of the median fins show very little deve ment, there being about 4 or 5 rays in the ca and only strong striations representing rays in

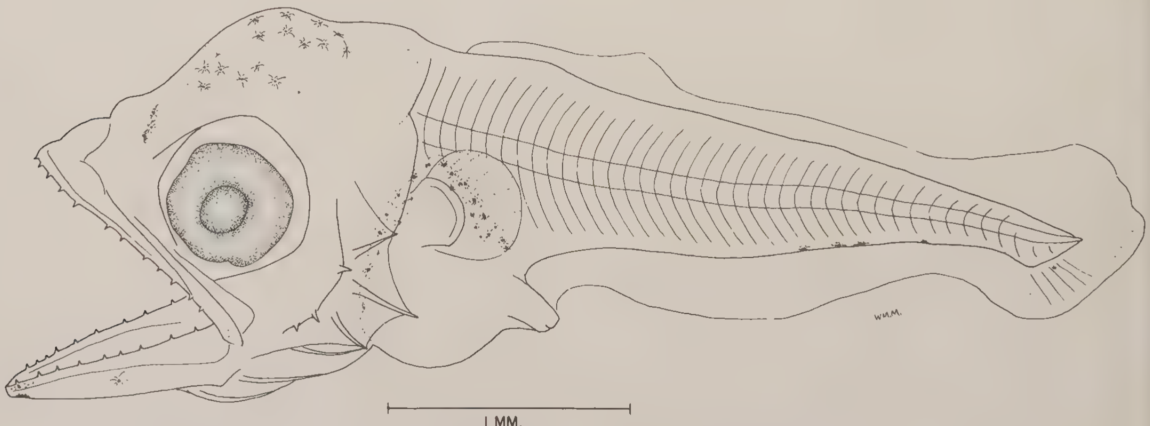

FIGURE 18.—*Euthynnus yaito*, 4.6 mm. total length.

gion of the future anal and dorsal fins. The
ctoral fins also show only striations, and the
lvic fins are absent.

The pigmentation on the head consists of 3
nall chromatophores over the forebrain and
bout 15 chromatophores over the midbrain.
here is a single small chromatophore at the
iddle of the mandible and another at the symphy-
s of the pectoral girdle, which is not shown in the
rawing. There is no pigmentation along the
orsal edge of the trunk, but 5 chromatophores
e present along the ventral margin of the trunk
ear the caudal region.

A 5.5-mm. specimen (fig. 19) shows marked
hanges. The proportions of the head, snout,
nd mouth closely resemble those of *K. pelamis*
ee table 4, p. 53). The mouth now contains 13
nd 15 teeth in the upper and lower jaws, respec-
vely, and the preopercular spines have increased
6.

There are 5 short spines in the first dorsal fin and about 9 rays in the caudal. The rest of the median fins and the pectorals still show only strong striations. The pelvic fins are just emerging as small buds.

Pigmentation is more extensive over the midbrain and over the abdominal sac. There is also an increase in the number of chromatophores at the tip of the snout and lower jaw, and the single chromatophore at the middle of the mandible and that at the pectoral symphysis are still evident. In addition, 2 small chromatophores are present on the ventral midline just anterior to the anus, and a single conspicuous chromatophore is present in the first dorsal fin. The dorsal midline of the trunk is still free from pigmentation, while the ventral midline shows 3 well-separated chromatophores in the region of the future anal finlets.

Some noticeable changes are present on the 7.6-mm. specimen (fig. 20), the most prominent

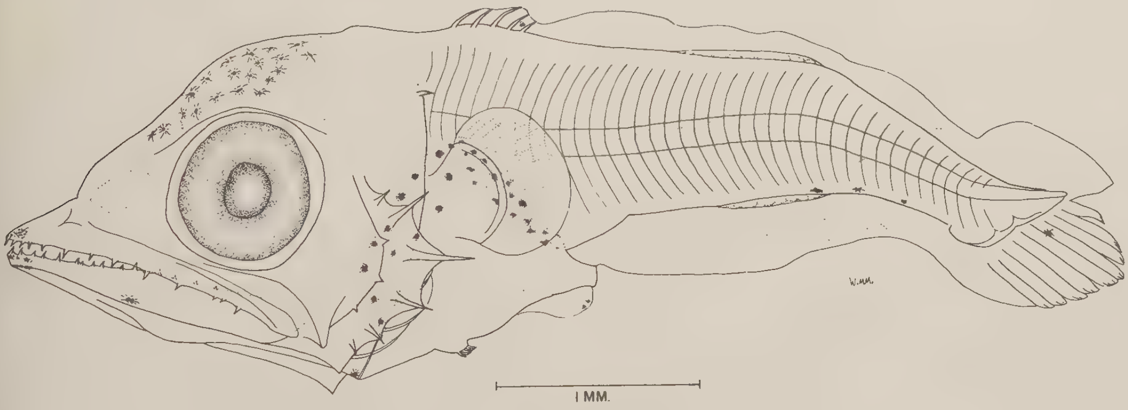

FIGURE 19.—*Euthynnus yaito*, 5.5 mm. total length.

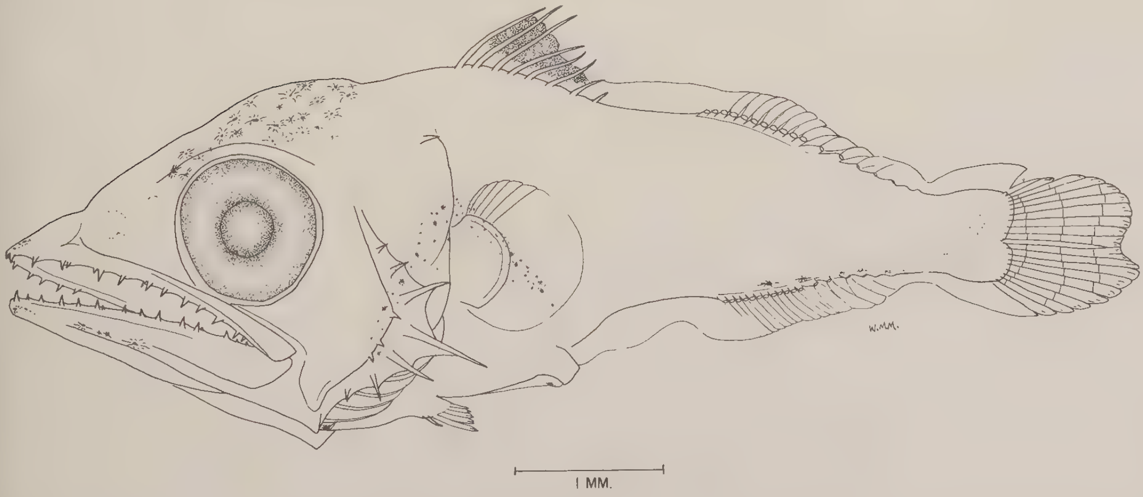

FIGURE 20.—*Euthynnus yaito*, 7.6 mm. total length.

of these being in the pigmentation. The first dorsal fin is almost completely pigmented and the anterior half of the mandible bears a series of 4 or 5 chromatophores.

The head is still large (39.8 percent of the total length) and the length of the snout is much greater than the diameter of the orbit. There are about 16 teeth on both the upper and lower jaws, and 7 spines are noticeable on the posterior edge of the preopercle.

The first dorsal fin has 8 spines, the length of the longest spine being slightly less than half the distance between the dorsal-fin insertions. The second dorsal and anal fin rays are beginning to form and, while the rays themselves are not clearly evident, there appear to be about 11 radials in the second dorsal and 12 in the anal. The radials of the first 7 dorsal finlets and first 6 anal finlets are also evident. The caudal fin shows 9+9 rays, and the pelvic fins, although very small, are complete with 1 spine and 5 rays. Only about 5 rays are noticeable in the pectoral fins. The myomeres remain the same (40 or 41) as in the previous specimen.

A 9.6-mm. specimen (fig. 21) already shows a close resemblance to the juveniles of *E. lineatus* (21 mm.) and *E. alletteratus* (25 mm.), insofar as pigmentation is concerned. The first dorsal fin is heavily pigmented, and the pigmentation at the tip of the snout is more extensive. The number of chromatophores along the lower jaw has increased and chromatophores now extend over two-thirds of the length of the mandible. The chromatophore at the symphysis of the pectoral girdle still persists, and the pigmentation over the re the body remains unchanged.

The relative sizes of the head, snout, and m are somewhat smaller than those of *K. pelamis* *N. macropterus*, and only 6 spines are evi along the preopercular edges.

There are 13 spines in the first dorsal fin length of the longest spine being greater than the distance between the dorsal-fin inserti The second dorsal and anal fins each contain rays. The finlets are poorly developed, but 8 7 finlet radials are clearly evident in the d and anal, respectively. The rest of the fins show an increase in the number of rays.

The largest specimen (not figured) in the s measures 12.25 mm. (tables 4 and 5). Its l is large (40 percent of the total length) and length of the snout is greater than the diam of the orbit. The mouth is also large, much m so than in *K. pelamis* and *N. macropterus*, contains 25 and 28 teeth in the upper and lo jaws, respectively. Staining with alizarin rev ed 39 (20+19) vertebrae.

The unpaired fins now have their full con ment of spines and rays, with 15 spines in the dorsal and 14 rays in the second dorsal, a dorsal finlets. The anal fin contains 14 rays 7 finlets. The longest spine in the first dorsa measures about half the distance between first and second dorsal-fin insertions.

The entire first dorsal fin from the first to tenth spine is completely pigmented. Small c matophores are present along the base of the dorsal fin and over the nape. A series of 4 wi

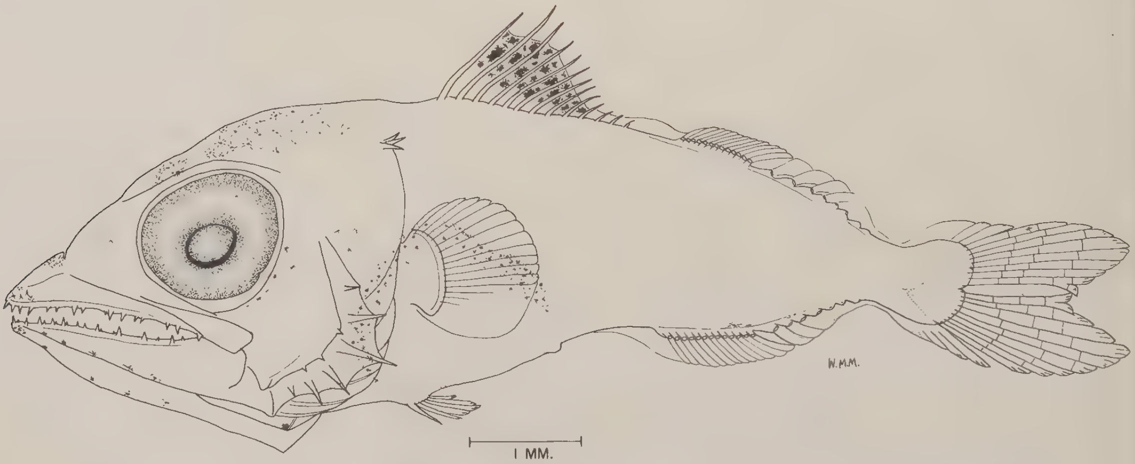

FIGURE 21.—*Euthynnus yaito*, 9.6 mm. total length.

paced chromatophores is seen along the posterior ase of the second dorsal fin and the bases of the rst 3 finlets. Similar pigmentation is also present t the bases of the last 3 anal rays and the first finlets. The lower jaw contains 8 well-spaced hromatophores distributed over its entire length, hile the rest of the pigmented areas remain as the 9.6-mm. specimen.

This last specimen has the same pigmentation as he 21-mm. and 26-mm. specimens of *E. lineatus* ken from the waters off Costa Rica by the Cali-rnia Department of Fish and Game. The only ajor difference is in the number of vertebrae, 7 (20+17), for the 21-mm. Costa Rican specimen s compared with 39 (20+19) for the 12.25-mm. pecimen just described.

FRIGATE MACKEREL (*AUXIS THAZARD*)

Of the 38 specimens of *A. thazard* taken by the *ugh M. Smith* (table 3), only a few specimens ere in suitable condition to permit accurate re-roduction. Consequently, specimens from the *ana* collection from the East and West Indies and he Gulf of Panama were used to complete the ries.

The 3.7-mm. specimen (fig. 22) described here s probably *A. thazard* is typical of the other speci-hens in the group ranging from 2.5 to 4.0 mm. in able 3. It has a short head with a very elongate ody containing 39 myomeres and tapering very radually toward the caudal end. The abdominal ac is triangular in shape with the anus located ell forward of the middle of the total body length. he greatest depth of the body is at the symphysis f the pectoral girdle, where it is about one-fourth f the total body length.

TABLE 3.—*Number and size range of larval* Auxis thazard *collected by the* Hugh M. Smith *in Hawaiian and equatorial waters*

[See figs. 1 and 2 for location of stations]

Cruise and station	Number of larvae	Size range (mm.)
HAWAIIAN WATERS:		
Cruise 6:		
No. 1A	1	3. 6
No. 7	1	6. 2
No. 8	4	2. 5–8. 2
No. 10	10	2. 7–3. 7
No. 11	2	7. 02, 8. 1
No. 13	12	3. 0–5. 2
Total	30	2. 5–8. 2
EQUATORIAL WATERS:		
Cruise 5:		
No. 21	2	2. 6
No. 51	2	4. 2, 5. 5
Cruise 14:		
No. 26	1	3. 6
No. 29	1	3. 1
Cruise 15: No. 3	1	7. 2
Cruise 18: No. 31	1	4. 0
Total	8	2. 6–7. 2

Since the snout is distorted, no comparisons of the head parts can be made. However, the snout appears very short and blunt and the mouth contains only 5 teeth, 3 on the upper jaw and 2 on the lower. Only 3 preopercular spines are noticeable, the middle one at the angle being the longest. Two small spines are also present on the preopercular surface.

The median fins are represented by a continuous fin membrane which starts at the nape and goes completely around the caudal end to a point slightly anterior to the anal opening. The pectoral fins are also membranous.

The pigmentation is most striking along the ventral midline of the caudal trunk, where 9 small, dark chromatophores are present. While the figured specimen shows a dark chromatophore on the dorsal midline of the caudal peduncle and 2

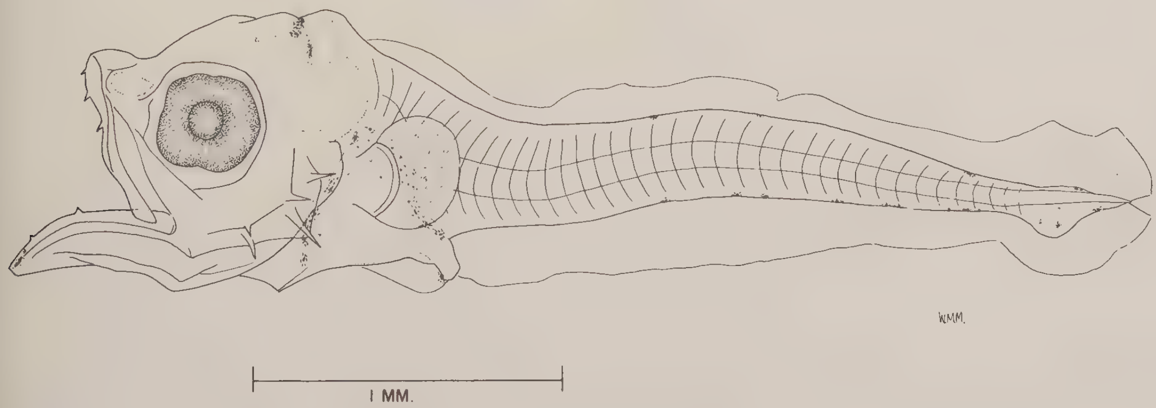

FIGURE 22.—*Auxis thazard* (?), 3.7 mm. total length.

more well-spaced and very light chromatophores near the middle of the body on the dorsal edge, other specimens show only the one on the caudal peduncle. On some specimens even this single chromatophore is absent. Several dark chromatophores are present along the posterior margin of the midbrain, and the very small chromatophores at the tip of the lower jaw are barely noticeable. The abdominal sac is pigmented regularly as in the other species, with most of the pigmentation concentrated along the anterior and dorsal surfaces. A single conspicuous chromatophore is present just anterior to the anal opening, and in this specimen the symphysis of the pectoral girdle does not show any pigmentation.

The smallest specimen identified confidently as *A. thazard* measures 4.5 mm. (fig. 23). The head is moderate (34.2 percent of the total body length) and the body contains 40 myomeres. The snout is short, slightly over three-fourths of the diameter of the orbit, and the mouth is moderately large and measures almost two-thirds of the head length. There are 5 small teeth on the upper jaw and 4 on the lower. The posterior edge of the preopercle bears 3 spines, the longest one located at the angle.

The pigmentation on the head consists of 6 large chromatophores over a small area of the midbrain and a faint tinge of pigment at the tip of the lower jaw. A single chromatophore is present at the symphysis of the pectoral girdle and another just anterior to the anus. The triangular abdominal sac is pigmented regularly, similarly to the three preceding species. A series of 2 to 3 chromatophores is present along the middorsal, midlateral, and midventral lines of the caudal region. In addition, 7 well-spaced chromatophores are pre
on the posterior half of the trunk along the m
ventral line.

The unpaired fins are represented by a cont
ous membrane and except for the caudal fin, wh
10 rays are evident, none of the others shows
fin rays. The pectoral fins are also membra
and the pelvic fins are absent.

Only a few changes are noticeable on a 5.5-m
specimen (fig. 24). The head is small and
moderate mouth, representing 60.3 percent of
head length, contains 12 teeth on each jaw.
snout is somewhat pointed and the distance f
its tip to the anterior edge of the orbit is al
four-fifths the diameter of the orbit. There
6 spines along the edge of the preopercle an
small spine is visible in the posttemporal reg

The fins, except for the pelvics, which app
as small buds, show relatively little change f
the specimen described above.

The pigmentation on the head consists of ab
13 chromatophores which are closely grou
over the midbrain, the rest of the head b
unpigmented. The abdominal sac remains
same as in the previous specimen. A series
to 4 chromatophores is present along the m
dorsal, midlateral, and midventral lines of
caudal region. In addition, 2 widely spa
chromatophores are present along the ven
midline anterior to the caudal peduncle.

Further changes are apparent on a 7.05-m
specimen (fig. 25). The head is slightly la
and the anus is at the middle of the total len
of the body. The snout is pointed and is alm
equal in length to the diameter of the or
The mouth is large and represents 61.4 perc

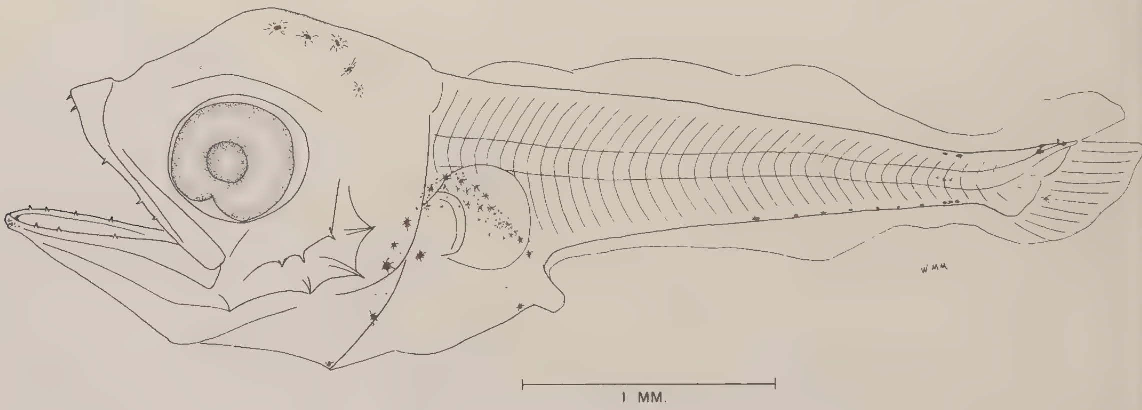

FIGURE 23.—*Auxis thazard*, 4.5 mm. total length.

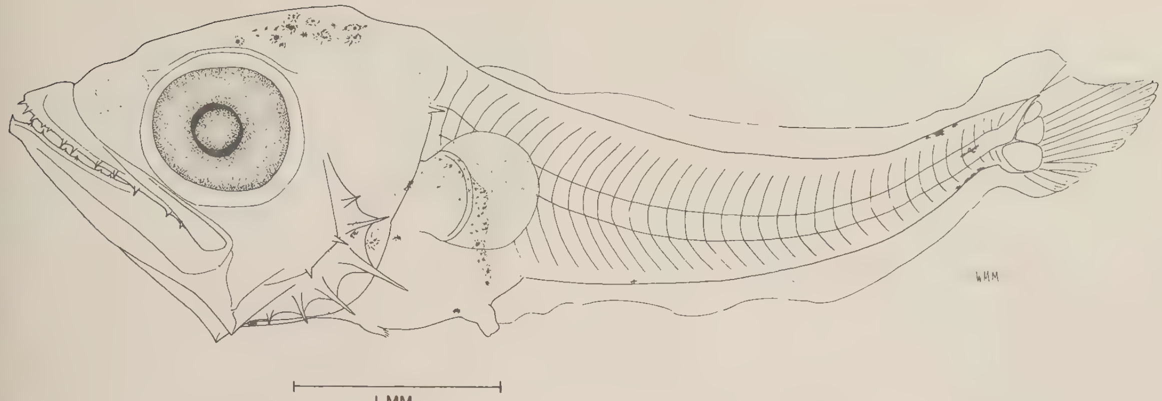

FIGURE 24.—*Auxis thazard*, 5.5 mm. total length.

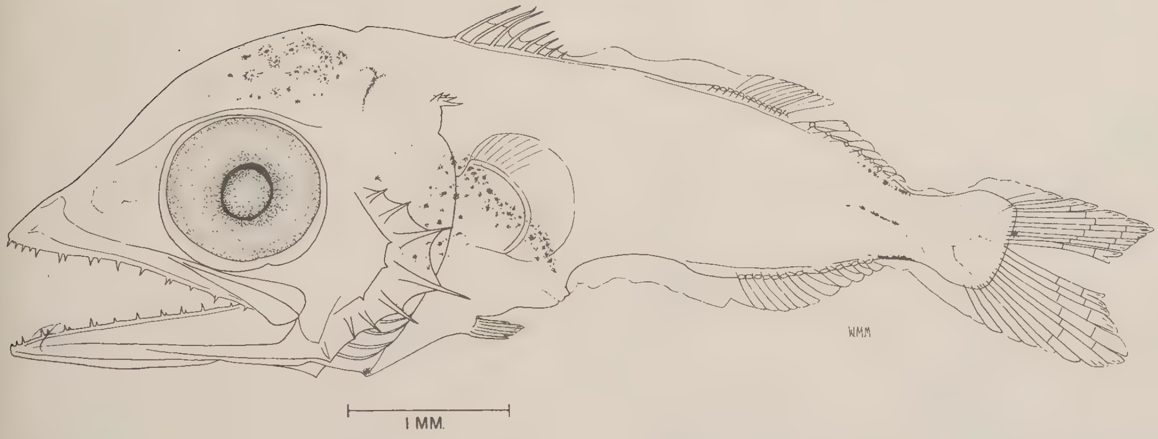

FIGURE 25.—*Auxis thazard*, 7.05 mm. total length.

f the head length. Sixteen to seventeen promi-ent teeth are present on each ramus of the upper nd lower jaws, and 1 tooth is evident on the alatine bone. There are 7 preopercular spines: spines on both the vertical and horizontal edges nd 3 long spines at the angle, the middle one eing the longest. The single posttemporal spine ow has 4 prongs.

The first dorsal fin has 8 spines, the second hrough the fourth spines being longer than the rst. The length of the longest spine is less than ne-third the distance between the insertions of he first and second dorsal fins. About 10 rays re present in the second dorsal fin, followed by or 7 dorsal finlets. The anal fin contains about rays and 4 to 5 finlets, while the caudal fin ith 10+11 rays is just beginning to fork. The ectoral fins have 7 rays, and the well-developed elvic fins have 1 spine and 3 to 4 rays.

The pigmentation over the head and the abdominal sac is more extensive than on the previous specimen, and the chromatophores on the caudal region now number 6, 5, and 4 along the mid-dorsal, midlateral, and midventral lines, respectively. The chromatophore at the symphysis of the pectoral girdle is still present, but the single chromatophore anterior to the anal opening is absent. In addition to these, only 1 very faint chromatophore is present on the side of the head near the dorsal origin of the preopercle.

After staining, the 7.05-mm. specimen shows 11 completely ossified vertebrae. From the 12th through the 15th vertebrae only the bases of the neural and haemal arches are ossified. The urostyle is completely ossified, while the 2 preceding vertebrae are only partially so. There are 40 myomeres on this specimen.

Except for a slight increase in pigmentation, an 8.20-mm. specimen (not figured) shows development similar to that of the 7.05-mm. specimen just described. The most noticeable differences are the absence of the chromatophore at the symphysis of the pectoral girdle and the presence of a few small chromatophores on the first dorsal fin.

A 9.7-mm. specimen (fig. 26) has the same general appearance as the preceding specimen. The head (34.7 percent of the total length) appears small, while the anus is now located in the posterior half of the body.

There are 9 spines in the first dorsal fin, the length of the longest one being less than one-fourth the distance between the insertions of the first and second dorsal fins. There are 12 rays in the second dorsal followed by 8 dorsal finlets. The anal consists of 10 rays and 7 finlets. Each pectoral fin contains 15 rays, while the pelvics are complete with 1 spine and 5 rays. The caudal fin consists of 12 dorsal and 13 ventral rays.

Only slight changes are noted in the pigmentation, with 3 chromatophores present over the forebrain, 1 over the tip of the snout, and a few scattered chromatophores over the preoper The series of chromatophores along the middo line has increased to 16 and extends almost to insertion of the second dorsal fin. Similarly, chromatophores along the midventral line have extended forward to the middle of the fin. The midlateral series contains 7 chrom phores.

The 11.2-mm. specimen (fig. 27) differs several ways from the 9.7-mm. specimen. head and snout appear much smaller than th of the three previous species. The mouth, h ever, is moderate (representing 58.6 percent of head length) and contains 21 and 18 teeth the upper and lower jaws, respectively. anus has moved back still further, and the ab minal sac has become more elongate. The na depression has completely divided into two se rate nostrils, the anterior one being associa with the nasal rosette.

The dorsal and anal fins and finlets have full complement of spines and rays, and

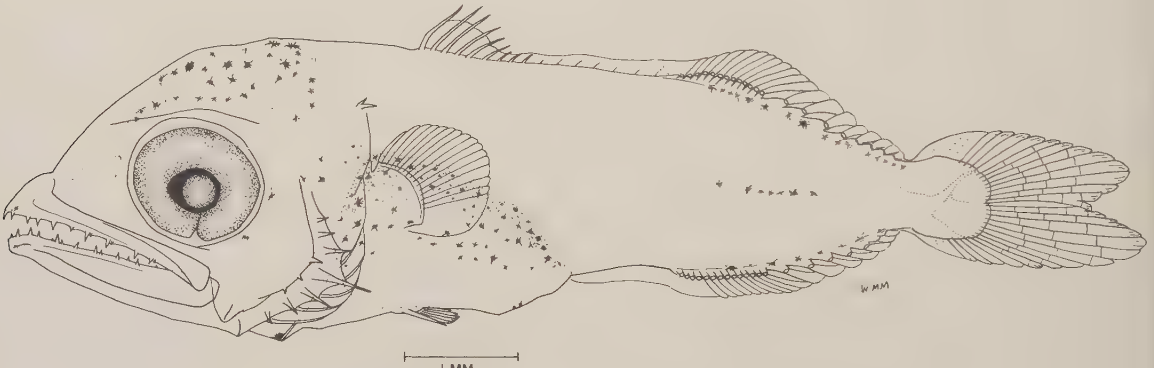

FIGURE 26.—*Auxis thazard*, 9.7 mm. total length

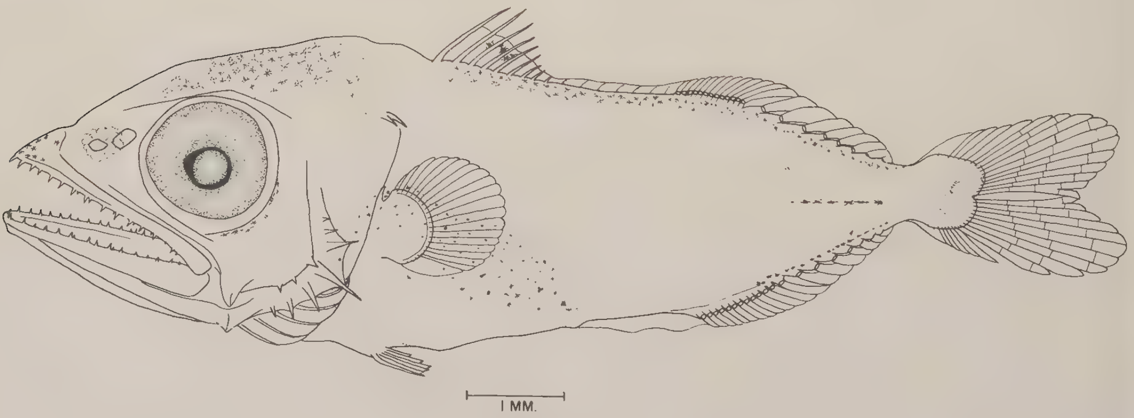

FIGURE 27.—*Auxis thazard*, 11.2 mm. total length.

ength of the longest spine of the first dorsal fin slightly less than one-third the distance etween the first and second dorsal-fin insertions. he pectoral fins have 19 or 20 rays, while the audal fin consists of 14+14 rays.

There are quite a few changes in the pigmenta-ion at this size. The first dorsal fin contains 3 rge chromatophores, and the pigmentation over he dorsal edge of the body now extends to the rigin of the first dorsal fin. Other areas showing creased pigmentation are the snout, midbrain, nd posteroventral margin of the orbit.

The 11.2-mm. specimen has 7 rather weak spines epresenting the future subcutaneous spines of the orsal interspace (Schaefer and Marr, 1948a). he specimens of juvenile *A. thazard* measuring etween 11 and 50 mm. from Costa Rica, Colom-ia, and the Galapagos Islands also have weak pines in the dorsal interspace. In many instances hese spines project freely and are easily seen. n the basis of all characters considered, the rvae described here are identical with the uveniles of *A. thazard* from the coastal waters of entral America.

COMPARISON OF SPECIES

It is extremely difficult, if not impossible, to ifferentiate the larvae of various species of tuna y using the methods employed in identifying the dults. Measurements and meristic counts are ot applicable because the larvae are undergoing apid growth and differentiation. Development is pparently so rapid that even specimens of com-arable sizes show marked differences in many haracters.

During this study it was found that certain hromatophores and patterns of pigmentation ersisted throughout the size ranges examined, d these markings seemed much more reliable han the other characters. Consequently, iden-ification and description of the various species ere based primarily on pigmentation, and the her characters were used only supplementally ables 4 and 5).

TABLE 4.—*Comparison of body proportions among larvae of four species of tuna, by total length*

[Asterisk (*) indicates measurements not accurate; snout distorted in preservation]

Size group	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Euthynnus yaito*	*Auxis thazard*
Head length/ total length:	*Percent*	*Percent*	*Percent*	*Percent*
3 mm	*31.2	*28.3		*25.3
4 mm			33.9	34.2
5 mm	36.8	38.7	37.7	35.8
6 mm	32.4	38.5	41.7	33.0
7 mm	35.2	43.2	39.8	39.4
8 mm	36.4	41.3	38.8	
9 mm	37 9		33.5	34.7
10 mm		38.4		36.2
11 mm				36.3
12 mm			40.0	
14 mm	39.7	37.2		
Mouth length/head length:				
3 mm	*57.8	*69.7		*59.4
4 mm			71.9	65.4
5 mm	60.1	71.6	72.0	60.3
6 mm	57.0	68.2	66.0	63.1
7 mm	62.1	68.6	67.1	61.4
8 mm	60.5	66.0	61.3	
9 mm	61.9		59.1	56.9
10 mm		67.9		55.7
11 mm				58.6
12 mm			65.3	
14 mm	56.9	57.9		
Snout length/orbit diameter:				
3 mm	*65.0	*75.0		*66.7
4 mm			99.9	85.0
5 mm	68.9	103.6	103.6	81.5
6 mm	70.5	98.2	105.8	88.2
7 mm	86.2	94.1	117.4	90.7
8 mm	82.7	93.9	91.3	
9 mm	104.3		91.6	86.4
10 mm		103.4		78.6
11 mm				88.4
12 mm			112.9	
14 mm	100.6	87.5		
Total length of specimen:	*Mm.*	*Mm.*	*Mm.*	*Mm.*
3 mm	*3.90	*3.70		*3.70
4 mm			4.60	4.50
5 mm	5.50	5.35	5.50	5.50
6 mm	6.40	6.70	6.00	6.25
7 mm	7.15	7.10	7.60	7.05
8 mm	7.95	8.75	8.00	
9 mm	9.20		9.60	9.70
10 mm		10.90		10.90
11 mm				11.20
12 mm			12.25	
14 mm	14.25	14.50		

Among the four species described, *E. yaito* and *. thazard* can be separated from *N. macropterus* d *K. pelamis* quite readily by the pigmentation the body. Larvae of both species bear a single romatophore at the symphysis of the pectoral rdle and another on the midline of the body just anterior to the anal opening. The occurrence of these chromatophores is somewhat variable, and in some instances either one of the two may be absent. Nevertheless, the presence of either one is quite conclusive evidence that the specimen is either *E. yaito* or *A. thazard*, since no other species examined has these chromatophores. Mead (1951), in his descriptions of *A. thazard* and *E. lineatus* from the Pacific coast of Central America, found that the chromatophore at the symphysis of the pectoral girdle was present in the majority of his specimens. Wade (1951) did not mention this chromatophore, but our examination of the larvae collected by him from Philippine waters showed it to be regularly present on specimens which he designated as *E. yaito* and *Auxis* sp.(?), and absent from *K. pelamis* and *N. macropterus*. Besides this character, *E. yaito* and *A. thazard* bear a series of chromatophores (3 or more) along the ventral midline of the caudal trunk.

Three, or possibly four, distinctive patterns of pigmentation permit the separation of *E. yaito* from *A. thazard*. The first dorsal fin is generally more heavily pigmented in *E. yaito*. The first sign of this pigmentation is seen on a 5.5-mm. specimen with the appearance of 1 faint chromatophore. When the species is about 7 mm. in length the distal half of the first dorsal fin pears black. The pigmented area increases w growth of the larva and the entire fin is alm completely pigmented at about 12 mm. In *thazard* this pigmentation does not start to ap until the species has attained a length of a 10 mm. An 11.2-mm. specimen has only 2 faint chromatophores near the distal edge of fin membrane.

TABLE 5.—*Summary of the more prominent diagnostic characters of tuna larvae at various sizes, by species*

Character	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Euthynnus yaito*	*Auxis thazard*
	3.9 mm.	**3.7 mm.**	**4.6 mm.**[1]	**4.5 mm.**[1]
Teeth	Not clearly seen	4 upper; 6 lower	12 upper; 9 lower	5 upper; 4 lower.
Preopercular spines	3	3	3	3.
Myomeres	About 40	Incomplete	40	40.
1st dorsal spines				
1st dorsal fin outline				
Pigmentation:				
1st dorsal fin				
Middorsal line	No chromatophores	No chromatophores	No chromatophores	2 chromatophores on c peduncle.
Midlateral line	do	do	do	3 chromatophores on c peduncle.
Midventral line	do	1 chromatophore on caudal peduncle.	5 chromatophores on posterior half of body.	3 chromatophores on c peduncle; 7 to midd body.
Tip of pectoral girdle	do	No chromatophores	1 chromatophore	1 chromatophore.
Anal opening	do	do	No chromatophores	Do.
Midbrain	4 chromatophores over small area.	10 chromatophores over large area.	15 chromatophores over large area.	6 chromatophores over area.
Forebrain	No chromatophores	No chromatophores	3 chromatophores	No chromatophores.
Mandible (other than at tip)	do	do	1 chromatophore at middle	Do.
	5.5 mm.	**5.35 mm.**	**5.5 mm.**[1]	**5.5 mm.**
Teeth	8 upper; 4 lower	13 upper; 11 lower	13 upper; 15 lower	12 each jaw.
Preopercular spines	6	6	6	6.
Myomeres	38	41 or 42	40 or 41	About 39.
1st dorsal spines			5; longest spine <⅓ dorsal interspace.[2]	
1st dorsal fin outline				
Pigmentation:				
1st dorsal fin			1 chromatophore	
Middorsal line	No chromatophores	No chromatophores	No chromatophores	3 chromatophores on c peduncle.
Midlateral line	do	do	do	2–3 chromatophores on c peduncle.
Midventral line	do	1 chromatophore on caudal peduncle.	3 chromatophores at bases anal and finlets.	4 chromatophores on c peduncle; 2 near mi body.
Tip of pectoral girdle	do	No chromatophores	1 chromatophore	1 chromatophore.
Anal opening	do	do	2 chromatophores	Do.
Midbrain	14 chromatophores over small area.	24 chromatophores over large area.	18 chromatophores over wide area.	13 chromatophores ove erate area.
Forebrain	No chromatophores	No chromatophores	3 chromatophores	No chromatophores.
Mandible (other than at tip)	do	do	1 chromatophore at middle	Do.
	7.15 mm.	**7.1 mm.**	**7.6 mm.**[1]	**7.05 mm.**
Teeth	10–11 upper; 6–7 lower	15 each jaw	16 each jaw	16–17 each jaw.
Preopercular spines	6	7	7	7.
Myomeres	40	41	40 or 41	40.
1st dorsal spines	7; longest spine <½ dorsal interspace.[2]	8; longest spine <⅓ dorsal interspace.[2]	8; longest spine <½ dorsal interspace.[2]	8; longest spine <⅓ dors terspace.[2]
1st dorsal fin outline				
Pigmentation:				
1st dorsal fin	6 chromatophores	1 chromatophore	Almost completely pigmented.	No chromatophores.
Middorsal line	No chromatophores	No chromatophores	No chromatophores	6 chromatophores on c peduncle.
Midlateral line	do	do	do	5 chromatophores on c peduncle.
Midventral line	do	1 chromatophore on caudal peduncle.	2 chromatophores—well separated.	4 chromatophores on c peduncle.
Tip of pectoral girdle	do	No chromatophores	1 chromatophore	1 chromatophore.
Anal opening	do	do	do	No chromatophores.
Midbrain	50+ chromatophores over small area.	50 chromatophores over large area.	45 chromatophores over entire area.	25 chromatophores over erate area.
Forebrain	No chromatophores	2 chromatophores	3 chromatophores	No chromatophores.
Mandible (other than at tip)	do	1 chromatophore ¼ distance from tip.	4–5 chromatophores over anterior half.	Do.

See footnotes at end of table.

TABLE 5.—*Summary of the more prominent diagnostic characters of tuna larvae at various sizes, by species*—Continued

Character	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Euthynnus yaito*	*Auxis thazard*
	7.95 mm.	**8.75 mm.**	**8.0 mm.**[1]	**7.7 mm.**[1]
eeth	9–10 each jaw	16–18 each jaw	18 upper; 19 lower	15 upper; 17 lower.
reopercular spines	7	7	7	7.
yomeres	40	41–42	40	40–41.
t dorsal spines	7	8 or 9	10; longest spine=⅔ dorsal interspace.[2]	6; longest spine=¼ dorsal interspace.[2]
t dorsal fin outline				
igmentation:				
1st dorsal fin	Almost entire height to 6th spine.	6 chromatophores on outer fin edge.	Large chromatophores on outer ⅔ of fin.	No chromatophores.
Middorsal line	No chromatophores	6–8 chromatophores at base 1st dorsal; 1 at origin 2d dorsal.	No chromatophores	8 chromatophores on caudal peduncle.
Midlateral line	do	No chromatophores	do	4 chromatophores on caudal peduncle.
Midventral line	do	3 chromatophores at base anal; 1 on caudal peduncle.	2 chromatophores at bases anal and finlet.	6 chromatophores at bases anal and finlet.
Tip of pectoral girdle	do	No chromatophores	1 chromatophore	1 chromatophore.
Anal opening	do	do	No chromatophores	Do.
Midbrain	22 chromatophores over small area.	45+chromatophores over wide area.	About 46 chromatophores over entire area.	About 25 chromatophores over fairly large area.
Forebrain	No chromatophores	2–3 chromatophores	5–6 chromatophores	No chromatophores.
Mandible (other than at tip)	do	1 chromatophore ½ distance from tip.	5 chromatophores over anterior half.	Do.
	9.2 mm.	**10.9 mm.**	**9.6 mm.**[1]	**9.7 mm.**[1]
eeth	12 each jaw	15 each jaw	17 upper; 19 lower	13 upper; 14 lower.
eopercular spines	7	9	6	7.
yomeres/vertebrae	13 ossified vertebrae (on 10.2-mm. specimen).	20+21 vertebrae (on 9.85-mm. specimen).	20+19 vertebrae (on 9.7-mm. stained specimen).	40 myomeres.
dorsal spines	10; longest spine=¾ dorsal interspace.[2]	13; longest spine <½ dorsal interspace.[2]	13; longest spine >½ dorsal interspace.[2]	9; longest spine <¼ dorsal interspace.[2]
dorsal fin outline	Slightly convex	Concave	Slightly concave	Convex(?).
gmentation:				
1st dorsal fin	Almost entire height to 8th spine.	Chromatophores on outer edge to 12th spine.	Distal ⅔ nearly completely black.	No chromatophores.
Middorsal line	No chromatophores	Chromatophores to 1st dorsal finlet.	No chromatophores	5 chromatophores on caudal peduncle; 11 chromatophores at bases 2d dorsal and finlets.
Midlateral line	do	6 chromatophores forward of caudal peduncle.	do	7 chromatophores on caudal peduncle.
Midventral line	do	4 chromatophores at bases anal and finlets; 1 on caudal peduncle.	2 chromatophores at bases anal and finlet.	3 chromatophores on caudal peduncle; 6 chromatophores at bases anal and finlets.
Tip of pectoral girdle	do	No chromatophores	1 chromatophore	1 chromatophore.
Anal opening	do	do	No chromatophores	2 chromatophores.
Midbrain	Chromatophores (number?) over small area.	80 chromatophores over large area.	23 chromatophores over large area.	About 25 chromatophores over large area.
Forebrain	No chromatophores	4 chromatophores	5 chromatophores	3 chromatophores.
Mandible (other than at tip)	do	1 chromatophore	4 chromatophores over anterior two-thirds.	No chromatophores.
	14.25 mm.	**14.5 mm.**	**12.25 mm.**[1]	**11.2 mm.**[1]
eth	13–14 each jaw	15 upper; 17 lower	25 upper; 28 lower	21 upper; 18 lower.
eopercular spines	6	8	8	7.
rtebrae	18+20 (on 12-mm. specimen)	20+21	20+19	Not observed.
dorsal spines	14; longest spine=⅗ dorsal interspace.[2]	16; longest spine=½ dorsal interspace.[2]	15; longest spine about ½ dorsal interspace.[2]	9; longest spine <⅓ dorsal interspace.[2]
dorsal fin outline	Convex	Concave	Concave	Convex(?).
gmentation:				
st dorsal fin	Completely black	6 or 7 chromatophores on outer edge of fin.	First 10 spines black	3 chromatophores near distal edge.
Middorsal line	Band of chromatophores to 1st finlet.	Band of chromatophores to 5th finlet.	4 chromatophores at bases 2d dorsal and finlets.	Series of chromatophores from 1st dorsal origin to caudal peduncle.
Midlateral line	No chromatophores	Band of chromatophores from 2d dorsal to 4th finlet.	No chromatophores	7 chromatophores on caudal peduncle.
Midventral line	do	Band of chromatophores at bases anal and finlets; 1 on caudal peduncle.	4 chromatophores at bases anal and finlets.	Series of chromatophores from anal insertion to caudal peduncle.
Tip of pectoral girdle	do	No chromatophores	1 chromatophore	1 chromatophore.
Anal opening	do	do	No chromatophores	No chromatophores.
Midbrain	Numerous chromatophores over small area.	Numerous chromatophores over large area.	Numerous chromatophores over large area.	About 36 chromatophores over medium-sized area.
Forebrain	No chromatophores	12 chromatophores	5 chromatophores	4 chromatophores.
Mandible (other than at tip)	do	Chromatophores on ⅔ of length.	8 chromatophores over entire length.	No chromatophores.

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[1] *Dana* Expedition collection.

[2] Distance between insertions of first and second dorsal fins.

The second character that separates these two ecies is the series of chromatophores along the andible in *E. yaito*. The first indication of man- bular pigmentation is seen in the 4.6-mm. specimen, where a single chromatophore appears at the middle of the lower jaw. *A. thazard* lacks this pigmentation until it reaches a length of about 15 mm. The only other species which has pigment on the mandible is *K. pelamis*, but in our specimens this species showed only 1 chromatophore at about 7 mm., and this persisted unchanged until a length of 10.9 mm. had been reached. At 14.5 mm. the mandible of *K. pelamis* is well pigmented, but at this size other characters easily separated it from *E. yaito*.

Two other areas of pigmentation in *A. thazard* help to separate it from *E. yaito*. These are the dorsal and lateral edges of the body in the caudal region. The chromatophores on the middorsal line are always present in *A. thazard*, while those on the midlateral line appear indistinct among the specimens below 4.5 mm.

It should be mentioned that in *A. thazard* pigmentation of the caudal region varies considerably, especially on the midlateral line. A number of specimens measuring up to 7 or 8 mm. lacked this pigmentation (fig. 28). Whether they represent another species, *A. tapeinosoma*, is difficult to determine, since a complete series of larvae of this type could not be assembled. All other characters of these specimens lead us to believe that they belong to the genus *Auxis*.

Several excellent characters separate *N. macropterus* from *K. pelamis*. Between 8.0 and 14.25 mm., *N. macropterus* can be distinguished from *K. pelamis* by the almost completely pigmented first dorsal fin. This pigmentation is first noticeable on a 6.4-mm. specimen and is represented by a single, small chromatophore. *K. pelamis* also has some pigmentation on the first dorsal fin, which seems to develop much later than in *N. macropterus*, for only 1 or 2 very faint chromatophores are present in specimens measuring about 7 mm.

Another notable character of *N. macropter* the complete lack of pigmentation in the ca region of the body until the larva approaches mm. In the remaining three species descr here, some pigmentation is present in the ca region at all sizes.

The final character which is peculiar to *macropterus* is the complete absence of pigme tion over the forebrain on specimens of all s In *K. pelamis* this pigmentation is present specimens down to 7.1 mm. *N. macrop* smaller than 7.15 mm. can be separated from *pelamis* by the small area of pigmentation half or less than half the area of the midbr whereas in *K. pelamis* this pigmentation exte over almost the entire midbrain area. The possible confusion in separating individuals these two species measuring less than 7.15 mm in the rare cases where the chromatophore at caudal peduncle of *K. pelamis* is absent. H ever, in such cases the relatively shorter snout smaller mouth of *N. macropterus* (table 4), toge with the difference in pigmentation over midbrain, help to separate these two species.

Among *N. macropterus* larger than 9.2 mm., outline of the first dorsal fin is definitely con and the longest spine of the fin is about th fifths the distance between the first and se dorsal fin insertions (table 5). The fin outli *K. pelamis* is concave in a 10.9-mm. specim and its longest spine is less than one-half the tance between the insertions of the first and se dorsal fins.

Larger specimens of *K. pelamis* can be readily identified by staining the vertebrae. count of 20 precaudal and 21 caudal vertebr

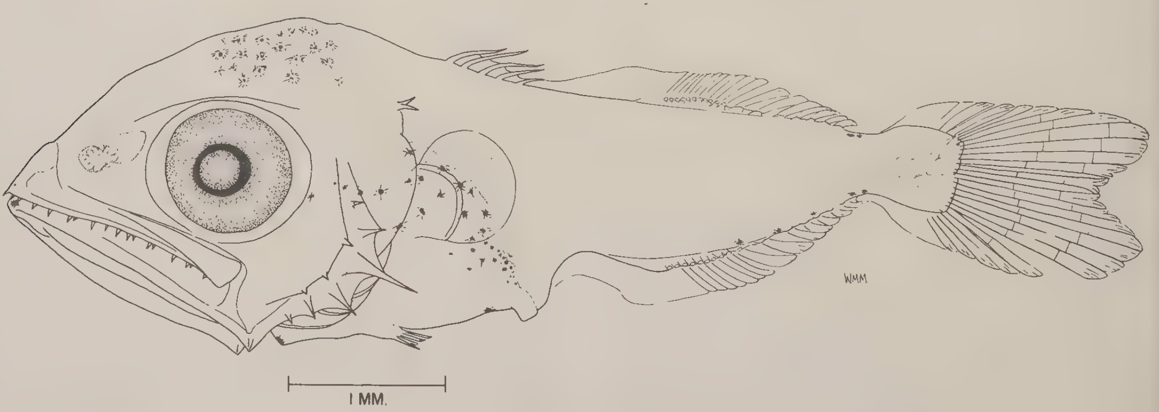


FIGURE 28.—*Auxis* sp. (?), 7.2 mm. total length.

finitive for this species, and this count can be tained from specimens measuring only 9.85 mm. here staining is not feasible, this species can be ntified by the single distinct chromatophore at e ventral midline of the caudal peduncle through- t the entire size range. This chromatophore is sent only rarely, but at times there may be 2 tead of the usual 1. Moreover, *K. pelamis* tween the sizes of 7.1 mm. and 10.9 mm. have ingle chromatophore near the tip of the man- le in the smaller specimens and near the middle the mandible in larger specimens.

K. pelamis smaller than 7.0 mm. can be dis- guished from the other species by the single romatophore at the midventral line of the udal peduncle, by the larger mouth and longer out, and by the large area of pigmentation over e midbrain. Forty-one or 42 myomeres can counted on specimens of *K. pelamis* whereas her species have 41 or fewer.

DISTRIBUTION OF TUNA LARVAE IN THE CENTRAL PACIFIC

In the sections to follow we shall discuss mainly e distribution of the two species of tuna, *Neo- nnus macropterus* and *Katsuwonus pelamis*, ich comprise the bulk of our catch of tuna vae, for the purpose of gaining some insight o the distribution and spawning habits of these n. Included are discussions on horizontal and rtical distribution, species composition of the tches, and spawning areas and seasons as evi- nced from the size composition of the catches. addition to the identified larvae there is a all, unidentified group consisting in the main of all (less than 3 mm.) and damaged larvae. ice there is little reason to suppose this group ntains additional species, this and the small oup of *Auxis thazard* are not considered in the cussions on distribution and spawning seasons.

A vast area of the Pacific was sampled, extending m 25° N. to 15° S. latitude and from 120° W. 180° longitude. The hydrography of this area s studied, and experimental fishing with long- e gear (described in Niska 1953) also was nducted in the region between 14° N. and 9° S. itude during the period when the plankton uls were made.

Hydrographic observations in this region indi- te a current system composed of a westerly flowing North Equatorial Current with its southern boundary varying with longitude and with season, but generally at about 10½° N. latitude; a westerly flowing South Equatorial Current with its northern edge at about 5½° N. latitude; and an easterly flowing Equatorial Countercurrent between the North and South Equatorial Currents. The width of the Countercurrent varies from 4° to 7½° and it shifts north and south over a distance of from 2° to 5° during different periods of time and at different longitudes (Cromwell 1954, table 1). These currents could have an important effect on the distribution of free-floating eggs and of newly hatched larvae, which are not yet capable of swimming about extensively.

HORIZONTAL DISTRIBUTION

Range of distribution

Approximate collecting locales for tuna larvae taken during 1950–52 are shown in figure 29. Each dot represents the occurrence of the designated species and has no quantitative connotation. Tuna larvae, both *N. macropterus* and *K. pelamis*, were taken as far north as 25° N. latitude in the vicinity of Midway Island, the most northerly area sampled during this period. Zooplankton collections presently being made in central Pacific waters up to about 45° N. latitude may show a further extension of the northern limit of larval-tuna distribution, for preliminary examination of zooplankton samples collected from this area (at 31° N. latitude along 143° W. longitude) during the winter of 1954 shows a few tuna larvae, too small for positive identification. South of the Equator, larvae have been taken at 14½° S. latitude in the vicinity of Samoa, the southernmost latitude at which a plankton station has been occupied by POFI vessels. In an east-west direction, larvae were taken at all longitudes sampled, from 120° W. to 180°. The area of larval occurrence as shown by the broken lines in figure 29 approaches 4 million square miles.

Latitudinal distribution of *Katsuwonus pelamis* and *Neothunnus macropterus*

The latitudinal distributions of the two species of tuna which comprise almost the entire larval-tuna catch in equatorial waters are plotted in figure 30, together with the corresponding adult catches on longline gear (the latter from Murphy and Shomura 1953a, 1953b). The north-south

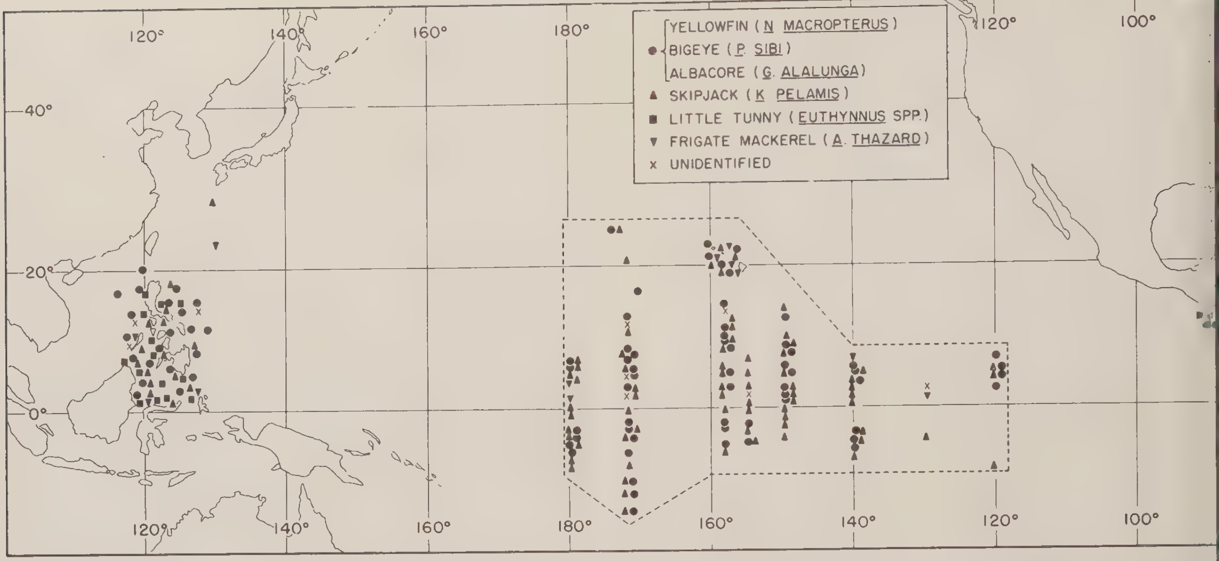


FIGURE 29.—Localities of capture of tuna larvae in the equatorial Pacific. Broken lines enclose area of POFI collec

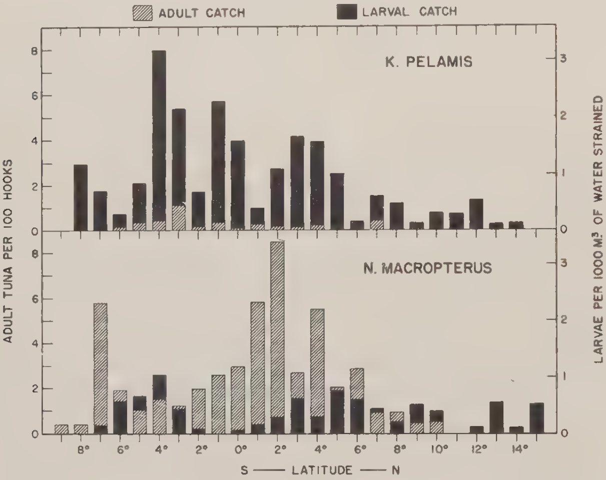


FIGURE 30.—Latitudinal distribution of the adult *Katsuwonus pelamis* and *Neothunnus macropterus*, as indicated by longline catch, and of the larvae.

range was limited by 14° N. and 9° S. latitudes in conformity with the range of fishing stations. The catch figures for both adults and larvae represent the averages of all the longitudes sampled during identical years.

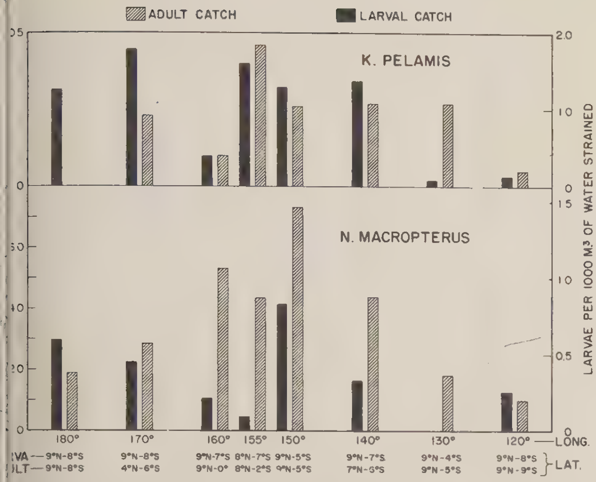
Although our longline catches may not provide a true measure of the abundance of adult *K. pelamis*, they would seem to indicate that the distribution of these fish (fig. 30, upper panel) is somewhat skewed to the south, with the peak at 3° S. latitude. Larval abundance shows a similar trend, but the latitudinal range of the larvae exceeds that of the adults. This is understanc when we realize that fishing effort was reduc the northern and southern extremities.

The adult *N. macropterus* catches (fig. lower panel) present a different distrib pattern. There are two peaks, one is sl north of the Equator and another at 7° sou the Equator. As explained by Murphy Shomura (1953a, 1953b, and 1955) the t especially *N. macropterus*, are perhaps indir associated with the phenomenon of upwelling occurs along the Equator. Large catches of *N. macropterus* were made slightly to the and south of the Equator where the up water had aged sufficiently to allow popula of tuna forage to develop. The larval *N.* *cropterus* catches show a similar, but more nounced, bimodal distribution which, althou is slightly displaced to the north, is likely re to the adult catches.

Longitudinal distribution of *Katsuwonus pelamis* and *Neothunnus macropterus*

Consideration of the larval-tuna catches (fig was limited to stations between 9° N. and latitude, the zone in which there was the concentrated fishing for adults, in order to pare the catches of larval and adult tuna.

It can be seen from the upper panel in figu that the abundance of *K. pelamis* larvae se fairly uniform from 180° to 140° W. long and the adult abundance was uniform from 17



GURE 31.—Longitudinal distribution of the adult *Katsuwonus pelamis* and *Neothunnus macropterus*, as indicated by longline catch, and of the larvae for the area 9° N. to 9° S. latitude.

130° W. longitude, apart from the low catches both larvae and adults at 160° W. longitude. he low catches of larvae at 130° W. and 120° W. ngitude suggest that there is little spawning of *pelamis* in this region.

The adult *N. macropterus* distribution varied ghtly from that of *K. pelamis* (fig. 31, lower nel), for they were found from 180° to 120° W. ngitude with a peak at 150° W. longitude. he larval *N. macropterus* abundance also aked at the 150th meridian, but aside from this ere was little correspondence in the density larvae and adults. The apparent absence of rvae at 130° W. longitude suggests that this longitude may be near the eastern limit of favorable *N. macropterus* spawning grounds. The salient feature of both *N. macropterus* and *K. pelamis* distribution is that, with the exception of *N. macropterus* along 130° W. longitude, tuna larvae were taken at all the longitudes where the adults were found.

West of 180° longitude the adults of *N. macropterus*, *K. pelamis*, and other tunas are caught all the way to the Asian coast. On the basis of the adult-larva relationship, it can be expected that tuna larvae will also be found in the region between 180° and the coast of Asia. This is not entirely supposition, for Wade (1950, 1951) has reported the capture of large numbers of these larvae from the waters surrounding the Philippine Islands. In the eastern Pacific, Schaefer and Marr (1948a, 1948b) and Mead (1951) found larval and juvenile tunas off the Pacific coast of Central America. The widely distributed records of larvae (fig. 29) together with the apparent parallels between adult and larval-tuna catch rates suggest that tuna larvae are generally distributed across the Pacific Ocean, although not necessarily with uniform abundance.

Records of larval-tuna captures in the Atlantic Ocean also seem to support the probability of a transoceanic distribution of tuna larvae. The Equatorial Current system roughly follows the same pattern in the Atlantic Ocean as in the Pacific Ocean, and tuna larvae have been taken (Ehrenbaum 1924) in a band of water between 32° N. and 7° S. latitude from the Cape Verde Islands to the coasts of Florida and Brazil (fig. 32).

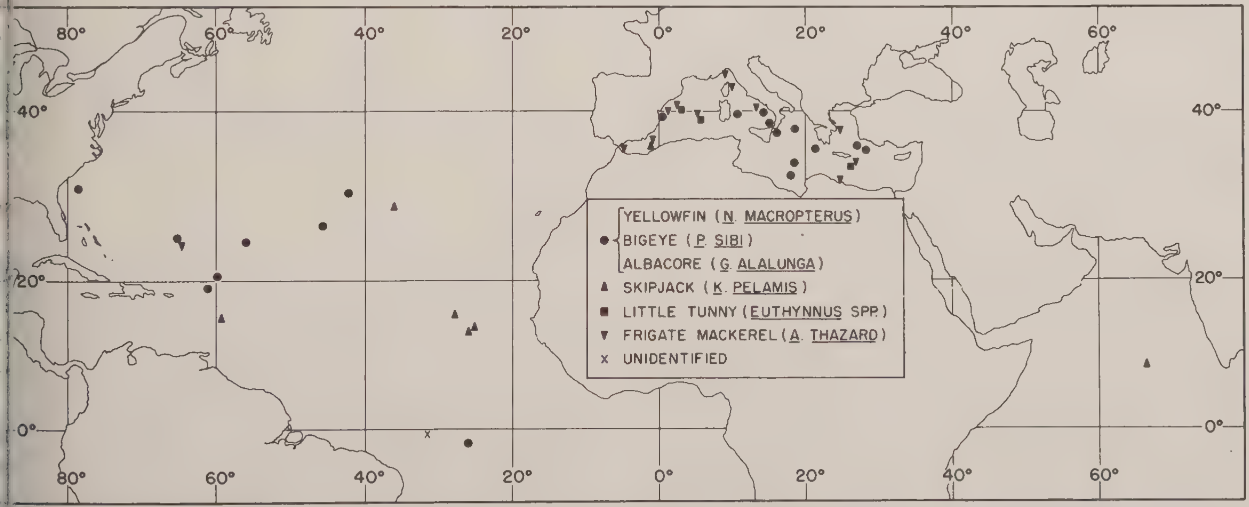


FIGURE 32.—Localities of capture of larval tunas in the Atlantic and Indian Oceans and in the Mediterranean Sea.

It is interesting to note that there are extensive records of larval tunas in the Mediterranean Sea and a record from the Indian Ocean.

VERTICAL DISTRIBUTION OF TUNA LARVAE

The data from cruise 6 of the *Hugh M. Smith* in Hawaiian waters (fig. 1) were used in studying the vertical distribution of tuna larvae. During each haul, 3 nonclosing nets, fishing at different depths, were towed simultaneously in a horizontal plane for 1 hour. At each station one of the following sets of towing depths was used: 0, 50, 150 meters; 0, 100, 150 meters; 0, 100, 200 meters; or 0, 150, 300 meters (appendix table 2, p. 68). The catches made on this cruise (table 6) show very clearly that tuna larvae are concentrated in the surface layers. Further, it is possible that all or most of the deep catches are contaminants, obtained while the nets were being raised and lowered.

Table 6.—*Abundance of tuna larvae in Hawaiian waters, per 1,000 cubic meters of water strained, for various depths and times of hauling*

[The figures in parentheses represent number of tows]

Time of tow	Depth in meters					
	Surface	50	100	150	200	300
Day	1.70(16)	0.42(4)	0.21(10)	0.08(8)	0.44(8)	0.36(2)
Night	8.49(9)	0.98(2)	0.55(4)	0.71(6)	1.18(3)	1.15(3)

The amount of contamination can be computed if the average concentration of larvae in the upper strata and the time spent by the net in passing through them are known.[2] It is interesting to note that, assuming the surface tows are representative of the upper 50 meters or the layer between the surface and the next shallowest net, contamination correction accounts for all of the deeper night catches and nearly all of the deeper day catches (fig. 33).

A vertical, diurnal migration of the larvae is suggested in the raw catches and is clearly shown when the surface tows are plotted according to the hour of hauling (fig. 34). (For the present, dodging is not considered; it will be shown later to be relatively unimportant.) Relatively

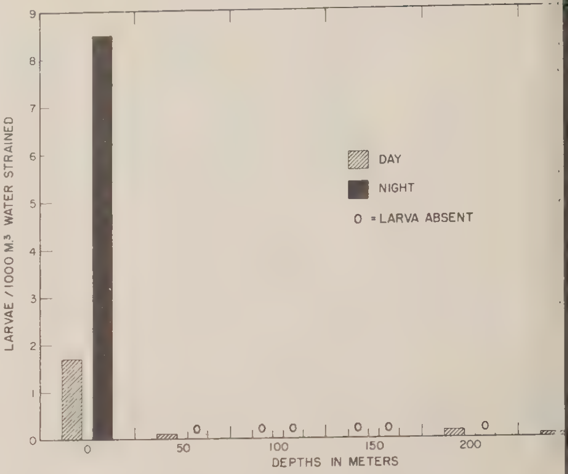


Figure 33.—Vertical distribution of tuna larvae
the Hawaiian area corrected for contamination, a
ing that the surface hauls are representative of the
50 meters.

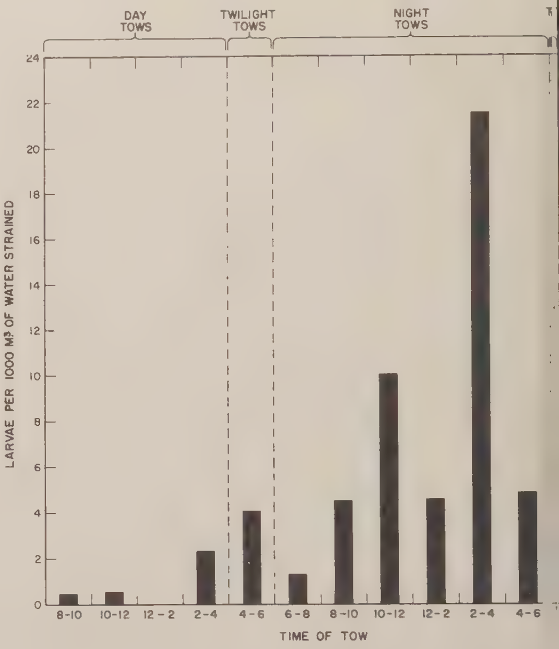


Figure 34.—Larval-tuna catch at various times
day.

catches were experienced during the day, whe
larvae presumably were beyond the depth o
surface net. The catches increased after tw
as the larvae apparently migrated to the su
the greatest catches being made between 10
and 4 a. m. The catches declined as the down
migration occurred with the approach of day

The depth of the diurnal, vertical migrati

---

[2] The following formula was used to compute contamination:

$$\text{Average number of contaminants}=\frac{\text{Average time a lower net spent in surface layer}}{\text{Average total elapsed time of tows of the surface net}}\times\text{Average surface catch.}$$

The several amounts were then subtracted from the figures in table 6 and the corrected catches plotted in figure 33.

e tuna larvae cannot be specified, but its maximum n be inferred from our material. A large series 200-meter oblique hauls in the equatorial region ble 7) shows no statistically significant diurnal riation ($t=1.421$, $P=0.14$), thus suggesting that gration may not occur down to 200 meters. at the migration is of even more limited scope suggested by the corrected vertical distribution g. 33). If migration occurs down to 200 meters, en in the horizontal tows the day catches at the eater depths should be larger than the night tches and also they should be larger than the y catches at the surface. The fact that the psurface catches are consistently less than the face day catches suggests a migration which is obably limited to a depth of less than 50 meters, d the main concentration of larvae in the day- ne occurred between the levels sampled by the rface and the 50-meter horizontal tows.

BLE 7.—*Comparison of day and night catches of tuna larvae by 200-meter oblique tows in equatorial waters*

Time of tow	Number of tows	Larvae/1,000 m.³ of water strained
y	49	1.50
ht	34	2.23

During the review of vertical migration and rtical distribution the problem of dodging was nporarily disregarded. It must be examined, wever, and its effect considered because it can ssibly bias comparisons of hauls between pths and between day and night. The pres- ce or absence of dodging can best be ex- nined in the 200-meter oblique tows, assuming at the net had passed through the entire vertical nge of larval distribution, thus minimizing or ssibly eliminating the effects of vertical migra- n in the catches. The night catches, although t significantly different from day catches, are out 1.5 times the latter (table 7), suggesting at dodging may have occurred. Even if the atively greater catches in the night hauls were e to dodging, it will be noted from table 6 that e ratio of night to day catches at the surface is ich greater (4.99: 1), suggesting a vertical mi- ation, despite allowances made for the effects of dging. Additional evidence in favor of vertical gration is provided by the relatively low night- y ratios at greater depths (table 6) as compared th the high ratio of the surface catches.

There is also little evidence in support of dodging when the frequency of captures of the larger larvae are considered, the implication here being that the larger larvae are more capable of dodging the net than are the smaller larvae. In the equatorial area, four larvae 10 mm. or larger were taken during the day and only one at night. In the Hawaiian area only two larvae over 10 mm. were obtained and these were taken at night.

Considering all the evidence, it appears that dodging may alter the catches but not enough to seriously bias our conclusions that most of the larvae live near the surface during both day and night, and that there is a vertical, diurnal migration through relatively shallow depths.

SPECIES COMPOSITION OF THE LARVAL CATCH

Our discussion of species composition is based entirely on catches from the equatorial area between 120° W. longitude and 180°, and 9° N. and 9° S. latitude so that the composition of the larval catch can be compared with that of adults from the same area. Three of the four species of tuna larvae described previously are represented in the plankton samples, while the larvae of two other species of tuna, *Parathunnus sibi* and *Germo alalunga*, either were not taken or were not recognized.

Of the three species of larvae identified (table 8), *A. thazard* constitutes an insignificant portion of the catch, 1.2 percent of the total number of tuna larvae. The *N. macropterus* and *K. pelamis* larvae comprise 22.5 and 59.2 percent, respectively. This is in contrast to the species composition of the longline catch of adults, 73.0 percent of which were *N. macropterus* and 4.4 percent *K. pelamis*. However, the longline catches probably do not provide a reliable estimate of the true abundance of *K.*

TABLE 8.—*Species composition of larval and adult tunas taken in equatorial waters*

Species	Larvae [1]		Adults [2]	
	Number taken	Percent of total catch	Number taken	Percent of total catch
Neothunnus macropterus	107	22.5	889	73.0
Katsuwonus pelamis	281	59.2	54	4.4
Auxis thazard	6	1.2		
Germo alalunga			68	5.6
Parathunnus sibi			206	16.9
Unidentified	81	17.0		
Total	475		1,217	

[1] Plankton hauls.
[2] Longline catches.

pelamis since the gear is designed and fished with the primary objective of capturing the much-larger, deep-swimming *N. macropterus*. Thus, the low catch figures for *K. pelamis* represent only a few chance catches made by the longline.

The predominance of *K. pelamis* larvae in the plankton catches presents an interesting indication of the probable adult concentration. If we assume that both species have the same fecundity and larval mortality, it would appear that the adult *K. pelamis* population is about two and one-half times that of the *N. macropterus*. However, it is known that the *K. pelamis* ovaries are smaller than the *N. macropterus* ovaries and contain fewer eggs; therefore, this estimate of the relative numerical predominance of *K. pelamis* is minimal. Thus, there is the possibility that a population of *K. pelamis* exists in this region of sufficient size to support a commercial fishery, if the schools can be located. To date, however, only a few schools, consisting mostly of small fish, have been observed and they have occurred mostly in the immediate vicinity of islands and atolls.

AREA AND LOCALITY OF SPAWNING

Most studies of spawning have been based upon observations on the condition of the gonads, and the spawning locality has been assumed to be near the site where females with running or nearly ripe eggs have been captured. This method is applicable to fishes with limited migratory movements or to those that are relatively weak swimmers. However, in the case of the tunas—fishes which possess tremendous swimming speed and range—the actual spawning site could be some distance from the locality in which adult females with nearly ripe gonads are taken. A more-nearly ideal approach to the problem of locating the spawning sites of these fishes would be to examine the less-motile stages in the life cycle, specifically the planktonic eggs and newly hatched larvae.

The present investigation was limited to the larval stages because it has not been possible to identify the eggs of the several tunas. Early larvae can be considered planktonic, and while they have limited powers of movement, it is reasonable to suspect that they do not stray very far from the actual spawning grounds. If this is so, then it can be hypothesized that the localities where tuna larvae are taken should represent the approximate spawning sites.

Three factors must be evaluated before reasoning can be applied to our data to esti the location of spawning grounds: (1) The siz the larvae at hatching; (2) the duration of incubational period, throughout which the are planktonic; and (3) the direction and velo of the currents.

Determination of size of larvae at hatchin Sanzo (1932, 1933), who observed the developm of the embryo in the eggs of *Orcynus thyn* and *Orcynus germo*,[3] reported that the lar measured from 2.44 to 3.04 mm. in total len at hatching. The egg diameters for these species were from 1.00 to 1.12 mm. for the form and 0.84 to 0.94 mm. for the latter. Comp tively, the eggs from ripe gonads collected du POFI cruises measured from 0.83 to 1.08 for *N. macropterus*, and from 1.00 to 1.21 mm. *P. sibi*. *K. pelamis* eggs were from 0.55 to mm. in diameter, but it is believed that this represent a somewhat earlier stage of matur The largest egg that Brock (1954) found du his investigation of the biology of *K. pela* measured 1.125 mm. in diameter, and should close to the size of the fully ripe eggs. If size has any bearing on size of the larva hatching, then newly hatched *N. macropterus* *K. pelamis* should fall within the size ranges g by Sanzo for two species of tuna, that 2.44–3.04 mm.

Determination of duration of incubational perio The embryonic development of six California fi (Budd 1940) indicates that various pelagic sp have incubational periods ranging from 9 264 hours, and that the eyed-embryo s regularly appears at about the middle of developmental period or slightly earlier. latter observation is supported by illustra presented by Kuntz and Radcliffe (1918) for pelagic eggs of six species of fish. It seems the appearance of the eyed-embryo is fixed ra definitely at about the middle of the incubati period. If this holds true for all pelagic e then the incubational period for tunas could approximated at not more than 4 days, since eyed-embryo eggs collected by Sanzo (1932, 1 hatched in less than 2 days.

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[3] Sanzo probably followed Lütken's terminology. If so, *O. thynnus* naeus) represents "the more or less 'short-finned' genuine tunafish *O. germo* (Lacépède) represents the "more or less 'long-finned' " (Lütken 1880). Thus, *O. thynnus* could be bluefin tuna and *O. germo* be either yellowfin or albacore.

irection and maximum velocities of currents in
central Pacific.—As stated previously, the
rth and South Equatorial Currents flow west-
d and the Equatorial Countercurrent flows
tward in this area. The maximum velocity of
North Equatorial Current during 1950–52
0.56 knots, while that of the South Equatorial
rrent was 1.55 knots, as measured on POFI
ises. The eastward-flowing Countercurrent
wed a maximum velocity of 1.16 knots. (Cur-
t speed in knots was converted from figures in
mwell 1951, 1954; Austin 1954; and Stroup
4.) It is well to bear in mind that the velocity
each current varies considerably throughout
width of the current and at different longi-
es (Cromwell 1954, figs. 21 and 27).

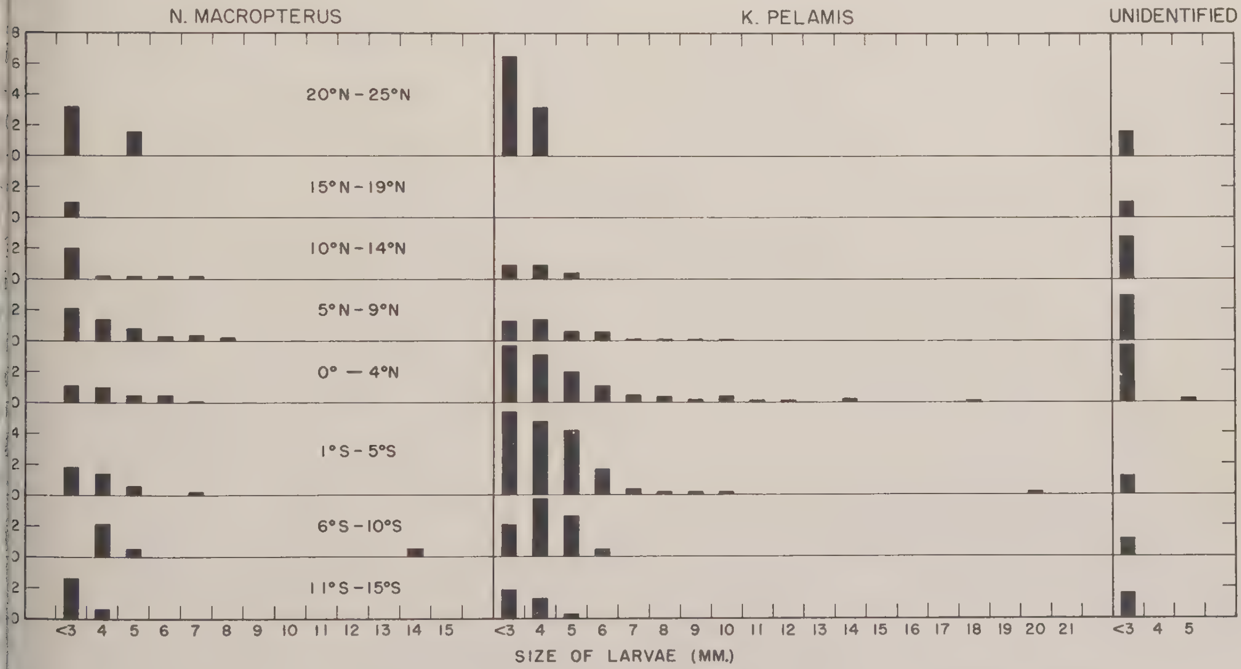
he implications in the foregoing discussions
that larvae measuring between 2.44 and 3.04
n. would have been adrift a maximum of 4
s prior to their hatching, and that these
vae could have drifted westward a distance
about 50 or 150 miles, depending on whether
y were in the North or the South Equatorial
rrent, or they could have drifted eastward a
tance of about 100 miles if they were in the
uatorial Countercurrent. The maximum drift
terms of longitudinal distance is about 2½°
stward and about 2° eastward.

In the present investigation larvae measuring between 2.50 and 3.90 mm. (which approximates the size of newly hatched larvae), presumed to be *K. pelamis* and *N. macropterus*, were taken at nearly all latitudes from 25° N. to 14½° S. (fig. 35), and also at nearly all longitudes sampled (fig. 36). They were caught at stations which generally were 5 to 10 longitudinal degrees apart and beyond the maximum drift to which these larvae could have been subjected. Thus, the presence of these newly hatched larvae along the various longitudes from 120° W. to 180° provides evidence that some spawning occurs throughout the area sampled.

TIME OF SPAWNING OF *KATSUWONUS PELAMIS* AND *NEOTHUNNUS MACROPTERUS*

Larval-catch data from equatorial waters for the years 1950–52 were segregated by months for each species, and the average catches from three bands of 10° of latitude, 5° N. to 14° N., 5° S. to 4° N., and 14° S. to 6° S. were then plotted to produce figure 37. The area was separated into such bands in order to see if there were seasonal spawning trends from north to south.

The plots show that *K. pelamis* larvae were found throughout the year and in fairly equal numbers each month between 5° N. and 14° N.



IGURE 35.—Latitudinal variation in size composition of tuna larvae caught between 120° W. and 180° longitude.

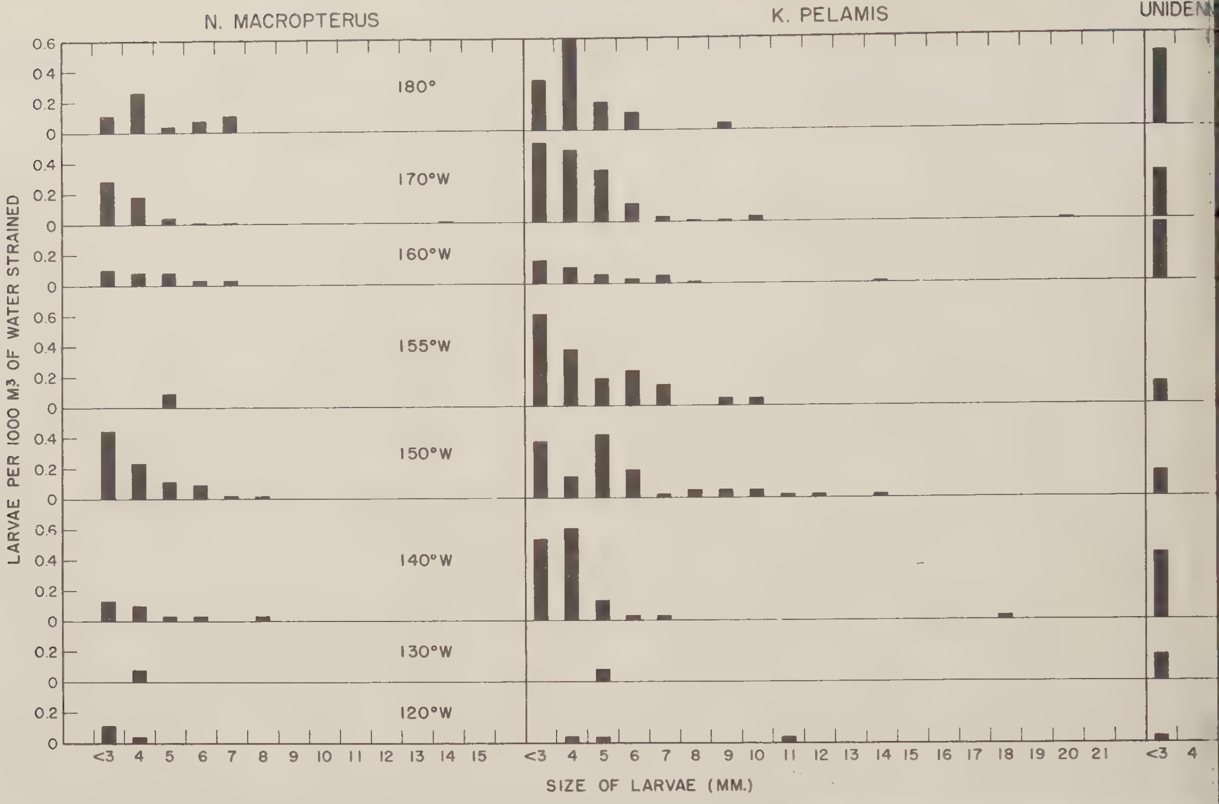


Figure 36.—Longitudinal variation in size composition of tuna larvae caught between 14° N. and 14° S. latitu

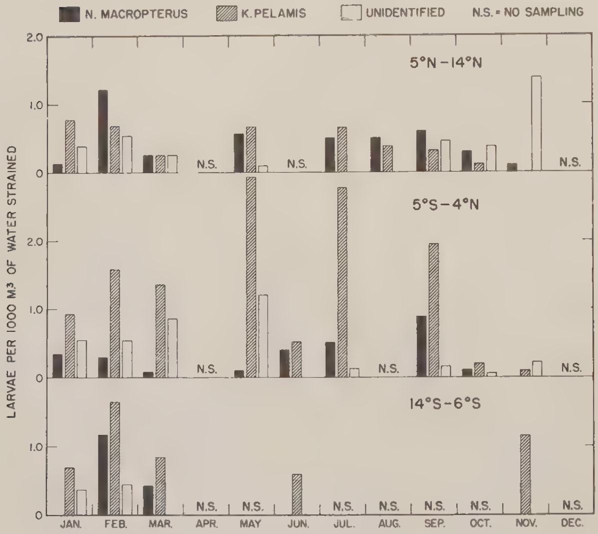


Figure 37.—Monthly catches of larvae in equatorial waters for three latitudinal zones, 1950 to 1952.

latitude. Substantially greater numbers of larvae occurred, however, between 4° N. and 5° S. latitude. Although this equatorial region pro-

duced *K. pelamis* larvae throughout the ye
showed a definite peak from May through
tember. South of 6° S. latitude larval *K. pe*
were rather uniformly abundant; however,
catches do not represent enough months to p
a more specific interpretation. In general, i
be hypothesized that while year-round *K. pel*
spawning occurs throughout the area bet
4° N. and 5° S. latitude, the spawning activ
greatest from May through September.

There are no significant peaks of *N. macrop*
spawning between 14° N. and 5° S. lati
However, a striking difference exists bet
the catches of *N. macropterus* and *K. pel*
larvae in the area south of 5° S. latitude. H
larvae of the former species were caught onl
February and March, none being taken in
uary, June, and November. Seasonal spaw
may occur in more southern waters, but
again data were obtained for too few month
form a definite opinion. As far as *N. macrop*
is concerned, it can be hypothesized that

ecies spawns throughout the area and through- t the year at a uniform intensity.

SUMMARY

. Four species of tuna larvae, yellowfin *eothunnus macropterus*), skipjack (*Katsuwonus* *amis*), little tunny (*Euthynnus yaito*), and gate mackerel (*Auxis thazard*), are described m plankton catches taken in central Pacific ters between 23° N. and 15° S. latitude and ° W. and 180° longitude and from the East lies and the Gulf of Panama.

. The most conspicuous, specific characters t distinguish the larvae are as follows:

. *Neothunnus macropterus:* Absence of chro- tophores on the trunk, except over the visceral ss, until the larvae approach 14 mm.

. *Katsuwonus pelamis:* Presence of a distinct omatophore on the ventral midline of the dal region, and no chromatophore at the nphysis of the pectoral girdle.

. *Euthynnus yaito:* A series of chromatophores ng the midventral line of the trunk, from the inity of the anal fin base to the caudal region; sence (usually) of a chromatophore at the nphysis of the pectoral girdle.

. *Auxis thazard:* Three short series of closely chromatophores on the middorsal, midlateral, l midventral lines of the caudal region; presence ually) of a chromatophore at the symphysis of pectoral girdle.

. Larvae of *Katsuwonus pelamis* and *Neo-* *nnus macropterus* were found in the waters th of the Hawaiian Islands to approximately N. latitude and as far south as the Samoan nds near 15° S. latitude. The areas rich in val *Neothunnus macropterus* coincided with the as where the adults were frequently taken by glining. Along the Equator, larvae were nd between longitudes 120° W. and 180°, the t-west limits of the area investigated, with a idedly rich area between 140° W. and 180°. close adult-larva relationship suggests the sibility of a transoceanic distribution of these vae along the Equator.

. Larvae were found to be concentrated at or r the surface, especially at night. It seems ly that even in the daytime the bulk of the larvae occur at less than 50 meters. Diurnal migration probably occurs within this shallow zone.

5. The abundance of *Katsuwonus pelamis* larvae in the area implied that a sizeable stock of adult *Katsuwonus pelamis* occurred in equatorial waters.

6. Recently hatched larvae were found in nearly all latitudes, longitudes, and seasons, suggesting widespread, continuous spawning throughout the area sampled.

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APPENDIX

The following tables list by species the number tuna larvae collected from the POFI research ssel *Hugh M. Smith* on 8 cruises in the equatorial Pacific in 1950–52. The tables include only those cruises or parts of cruises, from which material for this study was obtained.

APPENDIX TABLE 1.—*Tuna larvae collected on* Hugh M. Smith *cruise 5 in equatorial waters*

[All hauls were oblique from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified	Total
	Latitude	Longitude								
					1,000 m.^{3}					
1	27°00′ N.	175°11′ W.	6-30-50	0945	1.25					
2	25°00′ N.	174°10′ W.	7- 1-50	0258	1.32	1	1			2
3	22°58′ N.	173°00′ W.	7- 1-50	2315	1.34					
4	21°00′ N.	172°00′ W.	7- 2-50	0415	0.74		3			3
5	19°00′ N.	171°52′ W.	7- 3-50	0807	1.25					
6	17°01′ N.	171°46′ W.	7- 3-50	1219	1.43					
7	15°00′ N.	171°54′ W.	7- 4-50	1649	0.89				1	1
8	14°00′ N.	171°57′ W.	7- 5-50	0123	0.85	1			1	2
9	13°00′ N.	172°01′ W.	7- 5-50	0950	1.33					
10	12°00′ N.	172°00′ W.	7- 5-50	1815	0.88					
11	11°03′ N.	172°00′ W.	7- 6-50	0315	1.33		3			3
12	9°54′ N.	172°02′ W.	7- 6-50	1213	1.78	1				1
13	8°54′ N.	172°00′ W.	7- 6-50	2012	1.19	2				2
14	7°59′ N.	171°57′ W.	7- 7-50	0350	1.62	1	4			5
15	6°59′ N.	171°46′ W.	7- 7-50	1226	1.58	1				1
16	6°02′ N.	171°56′ W.	7- 7-50	2130	1.38		2			2
17	5°00′ N.	172°02′ W.	7- 8-50	0845	1.82	1				1
18	4°00′ N.	172°03′ W.	7- 8-50	1659	1.35					
19	3°00′ N.	172°01′ W.	7- 9-50	0036	1.06		1			1
20	2°00′ N.	171°53′ W.	7- 9-50	0838	1.81				1	1
21	0°54′ N.	172°12′ W.	7- 9-50	1746	1.59	2	1	2	2	7
22	0°08′ S.	172°02′ W.	7-10-50	0143	1.94		8			8
23	1°00′ S.	171°57′ W.	7-10-50	0925	1.26		24			24
24	2°00′ S.	171°55′ W.	7-10-50	1740	1.41					
25	2°59′ S.	171°59′ W.	7-11-50	0133	1.31	1	17			18
26	4°05′ S.	171°56′ W.	7-11-50	1055	1.58	9	2			11
27	5°04′ S.	171°58′ W.	7-11-50	2110	1.63					
28	4°56′ S.	158°02′ W.	7-28-50	0556	1.38					
29	4°00′ S.	158°03′ W.	7-28-50	1324	0.64					
30	3°03′ S.	158°00′ W.	7-28-50	2137	0.87					
31	2°03′ S.	158°00′ W.	7-29-50	0550	0.65					
32	1°00′ S.	158°01′ W.	7-29-50	1418	1.00		1			1
33	0°02′ S.	157°58′ W.	7-29-50	2221	0.77					
34	0°57′ N.	157°57′ W.	7-30-50	0646	1.53					
35	2°00′ N.	158°07′ W.	7-30-50	1532	0.85		1			1
36	3°00′ N.	157°58′ W.	7-30-50	2302	0.97		6			6
37	4°00′ N.	158°03′ W.	7-31-50	0640	1.65		6			6
38	5°00′ N.	158°00′ W.	7-31-50	1750	1.18		1			1
39	6°00′ N.	157°57′ W.	8- 1-50	0144	1.31	1				1
40	7°00′ N.	157°57′ W.	8- 1-50	0854	0.95					
41	8°00′ N.	157°50′ W.	8- 1-50	1620	3.36	1				1
42	9°00′ N.	157°55′ W.	8- 2-50	0020	1.14	2	1			3
43	10°00′ N.	157°53′ W.	8- 2-50	0744	1.60	1	2			3
44	11°00′ N.	157°55′ W.	8- 2-50	1546	1.14					
45	11°59′ N.	158°04′ W.	8- 2-50	2343	1.03	1	4			5
46	13°00′ N.	157°58′ W.	8- 3-50	0800	1.46		1			1
47	14°00′ N.	157°54′ W.	8- 3-50	1639	1.31					
48	14°58′ N.	157°55′ W.	8- 4-50	0253	0.59	2				2
49	17°00′ N.	158°08′ W.	8- 4-50	1741	0.93					
50	19°02′ N.	157°59′ W.	8- 5-50	1006	1.03					
51	20°53′ N.	158°02′ W.	8- 5-50	2300	0.85	3	2	2		7

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[1] +11 zone time on stations 1 to 27; + 10 zone time on stations 28 to 51.

APPENDIX TABLE 2.—*Tuna larvae collected on* Hugh M. Smith *cruise 6 in Hawaiian waters*

[All hauls were 1-hour horizontal tows at depth indicated]

Station	Depth of haul	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified
		North latitude	West longitude							
	Meters					*1,000 m.³*				
No. 1	0	23°31′	161°05.5′	8-25-50	1405	2.05	1			
	50					1.99	1	1		
	150					3.14				1
No. 1A	0	22°45′	161°15′	8-25-50	2030	2.63	5	9	1	4
	50					2.81		2		3
	150					3.32				3
No. 2	0	21°57′	161°05′	8-26-50	0315	2.26	12			
	100					3.07		3		1
	200					4.01	1	1		
No. 3	0	21°09.5′	161°03′	8-26-50	1042	2.15				
	50					2.07				1
	150					2.60				
No. 4	0	20°20′	161°05′	8-26-50	1750	2.25		8		5
	100					2.80		1		
	200					3.57		1		
No. 5	0	19°25.5′	161°05′	8-27-50	0042	2.31	2	13		10
	150					3.11				
	300					3.70		1		1
No. 6	0	19°26′	159°50′	8-27-50	0950	2.39	2			
	100					2.48				
	200					3.98				
No. 7	0	20°16.5′	159°44′	8-27-50	1853	3.03	4		1	
	50					3.22		3		
	150					4.30	1	1		
No. 8	0	20°54′	159°47′	8-28-50	0507	2.84		5	1	2
	100					2.66				
	200					3.68	1	4	3	
No. 9	0	21°05.1′	159°50.5′	8-28-50	1350	2.46				
	50					2.49				1
	150					3.06				
No. 10	0	22°48.5′	159°51′	8-24-50	2239	2.33	10	21	2	22
	150					3.61		3	7	
	300					5.80	2	5	1	1
No. 11	0	23°27′	159°45.7′	8-25-50	0500	2.37	5	9	2	
	50					2.85				1
	150					4.21				
No. 12	0	22°43.3′	158°26′	8-24-50	1250	2.71				
	100					2.90				
	200					3.95				
No. 13	0	21°50′	158°30.6′	8-24-50	0528	2.01	4		7	3
	50					3.14	2	10	4	6
	150					3.56		2	1	2
No. 14	0	20°50′	158°32′	8-18-50	1720	2.29	11			2
	100					2.17	2			
	200					2.25				1
No. 15	0	20°15′	158°24′	8-19-50	2340	2.72	5	8		
	150					3.81		1		
	300					5.28	2	4		
No. 16	0	19°24′	158°23′	8-19-50	0750	3.38	3			
	100					3.48				
	200					3.06	1	6		
No. 17	0	18°30′	158°29′	8-19-50	1522	2.24				1
	100					3.31				
	150					4.09				
No. 18	0	18°22′	157°07.5′	8-20-50	0210	1.61	13	22		11
	100					2.43	2			
	200					3.61	1	5		3
No. 19	0	19°31′	157°10′	8-20-50	2311	2.73	1			
	100					3.93		1		
	150					4.78	1	2		
No. 20	0	20°23′	157°07′	8-21-50	0815	2.11				1
	150					3.15		1		
	300					4.29		1		
No. 21	0	20°55.5′	157°10.3′	8-21-50	1412	2.77	7			
	100					2.45	1			
	150					2.81				
No. 22	0	21°50′	157°10.5′	8-23-50	1754	2.59		1		1
	100					3.07				1
	200					4.07		1		
No. 23	0	22°39′	157°13′	8-23-50	1020	2.84				1
	50					2.99				
	150					3.64				
No. 24	0	22°40′	155°47′	8-22-50	2149	2.90	1			1
	100					3.34				
	200					5.03	1	3		
No. 25	0	21°56.3′	155°45.3′	8-22-50	1500	2.82	14			
	150					3.43				
	300					3.92	1	1		
No. 26	0	21°03.5′	155°50′	8-22-50	0711	2.11	6			
	100					3.07				1
	200					4.69				2
No. 27	0	20°30′	155°47.2′	8-22-50	0140	2.18	6	4		2
	50					2.30				
	150					3.88				
No. 28	0	18°32.5′	156°07′	8-20-50	1136	2.22				3
	100					2.58				
	200					4.08				1

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[1] Local civil time corresponding to +10 zone time.

APPENDIX TABLE 3.—*Tuna larvae collected on* Hugh M. Smith *cruise 7 in equatorial waters*

[All hauls were oblique tows from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified	Total
	Latitude	Longitude								
					1,000 m.³					
	20°30′ N.	158°00′ W.	10-17-50	1925	0.95					
	19°10′ N.	158°02′ W.	10-18-50	0532	0.90				2	2
	18°13′ N.	158°00′ W.	10-18-50	1326	1.11					
	17°10′ N.	158°00′ W.	10-18-50	2159	0.68					
	16°11′ N.	157°57′ W.	10-19-50	0506	0.70	(2)	(2)	(2)	(2)	(2)
	15°02′ N.	157°58′ W.	10-19-50	1250	1.00					
	14°03′ N.	157°59′ W.	10-19-50	1921	1.22				3	3
	12°57′ N.	157°57′ W.	10-20-50	0330	0.73					
	12°25′ N.	158°00′ W.	10-20-50	1729	1.22					
	11°08′ N.	158°01′ W.	10-21-50	1526	1.37					
	10°01′ N.	157°55′ W.	10-22-50	0724	1.43					
	8°52′ N.	157°45′ W.	10-23-50	0742	0.96					
	8°05′ N.	157°15′ W.	10-24-50	0742	1.41				2	2
	7°17′ N.	157°04′ W.	10-25-50	0727	1.70					
	5°57′ N.	157°05′ W.	10-26-50	0737	1.57				1	1
	5°19′ N.	157°20′ W.	10-27-50	0725	2.21	1	1		3	5
	4°23′ N.	157°30′ W.	10-28-50	0912	1.87		2			2
	3°17′ N.	157°53′ W.	10-29-50	0802	1.31				1	1
	2°01′ N.	157°34′ W.	11- 1-50	0812	1.59		1			1
	6°07′ N.	162°06′ W.	11- 6-50	0950	1.93					
	6°13′ N.	163°05′ W.	11- 7-50	0810	1.57				1	1
	6°59′ N.	163°54′ W.	11- 8-50	0808	1.75				4	4
	7°24′ N.	164°25′ W.	11- 9-50	0806	1.44					
	6°31′ N.	165°45′ W.	11-10-50	0813	1.52	1			10	11

+10 zone time on stations 1 to 21; +11 zone on stations 22 to 24.

[2] Sample missing.

APPENDIX TABLE 4.—*Tuna larvae collected on* Hugh M. Smith *cruise 8 in equatorial waters*

[All hauls were oblique tows from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified	Total
	Latitude	Longitude								
					1,000 m.³					
	20°48′ N.	157°30′ W.	1-14-51	2012	0.94				1	1
	18°47′ N.	158°01′ W.	1-15-51	1449	0.63					
	14°30′ N.	158°00′ W.	1-17-51	0925	0.43				3	3
	12°57′ N.	157°58′ W.	1-17-51	2251	0.82					
	11°59′ N.	157°50′ W.	1-18-51	0811	1.36					
	11°00′ N.	157°53′ W.	1-18-51	1633	1.40				3	3
	10°00′ N.	157°56′ W.	1-19-51	0224	1.83	2				2
	9°00′ N.	157°58′ W.	1-19-51	1154	0.99					
	8°04′ N.	157°58′ W.	1-19-51	2024	1.24		3			3
	7°08′ N.	157°58′ W.	1-20-51	0615	1.30					
	5°59′ N.	158°00′ W.	1-20-51	1505	1.81					
	5°00′ N.	158°00′ W.	1-20-51	2338	0.98					
	3°55′ N.	157°54′ W.	1-21-51	1100	0.98					
	3°02′ N.	157°57′ W.	1-21-51	2135	1.02	1				1
	2°00′ N.	158°01′ W.	1-21-51	0802	1.63				1	1
	0°58′ N.	158°07′ W.	1-22-51	1730	1.53					
	0°01′ N.	158°02′ W.	1-23-51	0328	1.93					
	0°55′ S.	157°54′ W.	1-23-51	1208	1.51		1			1
	2°00′ S.	158°00′ W.	1-23-51	2312	1.27	1				1
	3°00′ S.	158°05′ W.	1-24-51	0744	1.27	1			1	2
	4°00′ S	158°00′ W.	1-24-51	1550	1.07					
	5°00′ S.	158°00′ W.	1-24-51	2330	0.89	5				5
	6°01′ S.	158°06′ W.	1-25-51	0741	1.23		2		1	3
	7°00′ S.	158°01′ W.	1-25-51	1548	1.35					
	14°30′ S.	171°51′ W.	2. 26-51	1931	1.88	6	8		4	18
	11°56′ S.	171°59′ W.	2-27-51	1129	1.92	4	2		1	7
	10°05′ S.	171°52′ W.	2-28-51	0245	1.74	2	5		1	8
	8°00′ S.	171°56′ W.	2-28-51	1821	1.45		2			2
	7°01′ S.	171°54′ W.	3- 1-51	0238	1.05		2			2
	5°59′ S.	172°00′ W.	3- 1-51	1118	1.40	1				1
	5°00′ S.	172°15′ W.	3- 1-51	1930	1.51					
	4°00′ S.	172°06′ W.	3- 2-51	0735	1.51		4			4
	3°00′ S.	171°50′ W.	3- 2-51	1537	1.51	1	1		2	4
	2°00′ S.	172°02′ W.	3- 3-51	1612	1.59					
	0°57′ S.	172°00′ W.	3- 4-51	0047	1.39		1		1	2
	0°09′ N.	171°58′ W.	3- 4-51	0926	1.07		1		1	2
	1°04′ N.	172°00′ W.	3- 4-51	1702	0.98		1		2	3
	1°54′ N.	172°02′ W.	3- 5-51	0034	1.85		8		5	13
	2°48′ N.	172°04′ W.	3- 5-51	0834	1.33		3		1	4
	3°57′ N.	172°02′ W.	3- 5-51	1816	1.22					
	4°56′ N.	171°54′ W.	3- 6-51	0249	1.62	1	1			2
	5°55′ N.	171°50′ W.	3- 6-51	1105	1.43	1	1		1	3
	6°58′ N.	171°49′ W.	3- 6-51	1939	1.91		2			2
	7°56′ N.	171°51′ W.	3- 7-51	0407	1.50					
	9°00′ N.	171°58′ W.	3- 7-51	1315	1.54	1				1
	10°02′ N.	171°56′ W.	3- 7-51	2147	1.54					
	11°02′ N.	171°52′ W.	3- 8-51	0602	1.58				1	1
	12°00′ N.	171°52′ W.	3- 8-51	1417	1.51				2	2
	13°01′ N.	171°48′ W.	3- 8-51	2236	1.72	1				1
	13°58′ N.	171°24′ W.	3- 9-51	0650	1.27					
	15°00′ N.	170°52′ W.	3- 9-51	1557	1.31					
	16°58′ N.	169°42′ W.	3-10-51	0913	1.99				1	1
	18°58′ N.	168°27′ W.	3-11-51	0207	1.94					

+10 zone time on stations 1 to 26; +11 zone time on stations 77 to 105.

APPENDIX TABLE 5.—*Tuna larvae collected on* Hugh M. Smith *cruise 11 in equatorial waters*

[All hauls were oblique tows from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified	T
	Latitude	Longitude								
					1,000 $m.^3$					
No. 1	14°37′ N.	150°12′ W.	8-24-51	0854	1.44		1			
No. 2	13°06′ N.	149°58′ W.	8-25-51	0828	1.22					
No. 3	11°31′ N.	150°02′ W.	8-26-51	0832	1.90					
No. 4	9°41′ N.	150°01′ W.	8-27-51	0801	1.36	2				
No. 5	8°58′ N.	150°08′ W.	8-28-51	0722	1.85					
No. 6	7°59′ N.	149°51′ W.	8-29-51	0754	2.84	2	1			
No. 7	6°55′ N.	149°50′ W.	8-30-51	0734	1.69					
No. 8	5°59′ N.	149°55′ W.	8-31-51	0742	1.54	4				
No. 9	4°49′ N.	150°02′ W.	9- 1-51	0743	1.95	4	1			
No. 10	4°02′ N.	150°04′ W.	9- 2-51	0852	0.70	2	1		2	
No. 11	2°55′ N.	150°09′ W.	9- 3-51	0739	1.70	7	6			
No. 12	1°59′ N.	150°04′ W.	9- 4-51	0740	1.94	2	1			
No. 22	2°00′ N.	151°18′ W.	9-19-51	0743	1.29	3	2			
No. 23	0°55′ N.	149°54′ W.	9-20-51	0742	1.31	1	1			
No. 24	0°01′ S.	149°56′ W.	9-21-51	0743	1.47		2			
No. 25	1°03′ S.	150°16′ W.	9-22-51	0746	1.13					
No. 26	2°01′ S.	150°08′ W.	9-23-51	0737	1.19		2		1	
No. 27	3°34′ S.	150°05′ W.	9-24-51	0740	1.55		3			
No. 28	4°57′ S.	150°04′ W.	9-25-51	0906	1.34					
No. 29	4°00′ S.	150°00′ W.	9-25-51	2352	1.88		21			
No. 30	3°00′ S.	149°57′ W.	9-26-51	0858	1.64					
No. 31	2°00′ S.	150°02′ W.	9-26-51	1719	1.39		7		1	
No. 32	1°00′ S.	149°58′ W.	9-27-51	0210	1.51	(2)	(2)	(2)	(2)	(2
No. 33	0°02′ N.	150°00′ W.	9-27-51	1300	1.12	1	1			
No. 34	1°02′ N.	150°01′ W.	9-27-51	2332	1.57	(2)	(2)	(2)	(2)	(2
No. 35	2°01′ N.	149°53′ W.	9-28-51	0840	1.54	1				
No. 36	3°00′ N.	150°03′ W.	9-28-51	1715	1.63	1	1			
No. 37	3°58′ N.	150°00′ W.	9-29-51	0152	1.53	2	3			
No. 38	4°59′ N.	149°56′ W.	9-29-51	1038	1.07		1			
No. 39	5°56′ N.	150°00′ W.	9-29-51	1919	1.66					
No. 40	6°51′ N.	149°57′ W.	9-30-51	0343	1.63	3				
No. 41	7°51′ N.	150°57′ W.	9-30-51	1257	1.93		1		3	
No. 42	8°57′ N.	149°58′ W.	9-30-51	2233	1.47	1	1			
No. 43	10°00′ N.	150°13′ W.	10- 1-51	0709	1.79		1			
No. 44	10°58′ N.	150°02′ W.	10- 1-51	1554	1.73					
No. 45	11°59′ N.	150°03′ W.	10- 2-51	0042	1.47					
No. 46	13°00′ N.	149°56′ W.	10- 2-51	0907	1.60	4				
No. 47	14°01′ N.	150°03′ W.	10- 2-51	1733	1.78					
No. 48	15°02′ N.	150°01′ W.	10- 3-51	0144	1.60	(2)	(2)	(2)	(2)	
No. 49	17°00′ N.	150°42′ W.	10- 3-51	1653	1.94					
No. 50	19°00′ N.	151°19′ W.	10- 4-51	0750	1.97					

[1] +10 zone time on all stations.
[2] No sample.

Appendix Table 6.—*Tuna larvae collected on* Hugh M. Smith *cruise 14 in equatorial waters*

[All hauls were oblique tows from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified	Total
	Latitude	Longitude								
					1,000 $m.^3$					
	7°57′ N.	154°57′ W.	1–27–52	1158	1.01					
	6°55′ N.	154°57′ W.	1–27–52	2132	1.33		9			9
	5°53′ N.	154°55′ W.	1–28–52	0813	1.13					
	4°55′ N.	154°51′ W.	1–28–52	1707	1.53		1		1	2
	3°54′ N.	154°51′ W.	1–29–52	0207	1.32					
	2°56′ N.	154°59′ W.	1–29–52	1057	1.03					
	1°54′ N.	155°03′ W.	1–29–52	2010	1.15		1		1	2
	0°54′ N.	155°11′ W.	1–30–52	0837	1.33		1			1
	0°06′ S.	155°14′ W.	1–30–52	1905	2.05		14		1	15
	1°10′ S.	155°08′ W.	1–31–52	0452	1.65		2			2
	2°00′ S.	155°03′ W.	1–31–52	1200	1.48					
	3°00′ S.	154°58′ W.	1–31–52	2124	1.51	1	4			5
	4°00′ S.	155°07′ W.	2– 1–52	0707	1.39					
	4°58′ S.	155°00′ W.	2– 1–52	1920	1.25	1	3			4
	5°53′ S.	155°03′ W.	2– 2–52	0455	1.33					
	6°50′ S.	155°05′ W.	2– 2–52	1407	1.32					
	7°56′ S.	179°53′ W.	2–15–52	0116	1.89		2			2
	7°01′ S.	179°49′ W.	2–15–52	1053	1.67		3			3
	6°05′ S.	179°58′ W.	2–15–52	1800	1.55	3				3
	5°04′ S.	179°58′ W.	2–16–52	0529	1.76	1	7			8
	4°03′ S.	179°58′ W.	2–16–52	1506	1.31	2	8			10
	2°56′ S.	180°00′	2–17–52	0040	1.39	1	2			3
	1°52′ S.	179°54′ E.	2–17–52	1107	1.34					
	0°59′ S.	179°57′ E.	2–17–52	1932	1.64		1			1
	0°52′ N.	179°59′ E.	2–18–52	0520	1.21		2		3	5
	1°03′ N.	179°58′ W.	2–18–52	1615	1.51			1	4	5
	2°07′ N.	179°57′ W.	2–19–52	0210	1.07					
	3°06′ N.	179°57′ W.	2–19–52	1105	1.74					
	4°05′ N.	179°55′ W.	2–19–52	2008	1.47		4	1	2	7
	5°06′ N.	179°50′ W.	2–20–52	0505	1.70	4	4		1	9
	6°06′ N.	179°44′ W.	2–20–52	0211	1.45	2				2
	7°04′ N.	179°59′ E.	2–20–52	1108	1.61	3	1		3	7
	8°03′ N.	179°58′ W.	2–21–52	0759	1.39					
	8°54′ N.	179°55′ W.	2–21–52	1720	1.33					

-10 zone time on stations 1 to 16; +12 zone time on stations 17 to 34.

Appendix Table 7.—*Tuna larvae collected on* Hugh M. Smith *cruise 15 in equatorial waters*

[All hauls were oblique tows from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified	Total
	Latitude	Longitude								
					1,000 $m.^3$					
	8°59′ N.	139°56′ W.	5–28–52	0731	1.42					
	7°51′ N.	139°46′ W.	5–28–52	1839	1.62					
	7°00′ N.	140°00′ W.	5–29–52	0315	1.73			1		1
	6°36′ N.	139°44′ W.	5–29–52	1035	1.87					
	6°00′ N.	140°00′ W.	5–29–52	1727	2.06	4				4
	5°02′ N.	139°58′ W.	5–30–52	0208	1.90	2	7		1	10
	4°05′ N.	139°58′ W.	5–30–52	1003	2.17	1	10		2	13
	3°09′ N.	139°53′ W.	5–30–52	1838	1.51		10		10	20
	1°57′ N.	140°03′ W.	5–31–52	0344	2.46		8			8
	0°53′ N.	140°02′ W.	5–31–52	1237	1.70		1			1
	0°11′ S.	139°52′ W.	5–31–52	2138	2.06					
	1°02′ S.	139°52′ W.	6– 1–52	0515	1.95					
	2°00′ S.	139°50′ W.	6– 1–52	1257	1.57					
	3°00′ S.	139°52′ W.	6– 1–52	2026	1.52	1	3			4
	4°00′ S.	140°05′ W.	6– 2–52	0628	1.32	1	1			2
	5°30′ S.	139°57′ W.	6– 2–52	1839	1.36	1				1
	7°00′ S.	139°58′ W.	6– 3–52	0709	1.72		1			1

-9 zone time on all stations.

APPENDIX TABLE 8.—*Tuna larvae collected on* Hugh M. Smith *cruise 18 in equatorial waters*

[All hauls were oblique tows from 0 to 200 meters, of 30 minutes' duration]

Station	Position		Date	Time started [1]	Water strained	*Neothunnus macropterus*	*Katsuwonus pelamis*	*Auxis thazard*	Unidentified
	Latitude	Longitude							
					1,000 m.³				
No. 2	9°00′ N.	120°50′ W.	10-19-52	0012	1.53	----	----	----	----
No. 4	7°06′ N.	120°00′ W.	10-21-52	0200	1.24	2	----	----	2
No. 5	5°50′ N.	120°16′ W.	10-22-52	0217	3.29	2	1	----	----
No. 6	4°53′ N.	119°59′ W.	10-22-52	2325	1.45	1	1	----	----
No. 7	4°01′ N.	120°06′ W.	10-23-52	1200	1.53	----	----	----	----
No. 8	3°03′ N.	120°05′ W.	10-25-52	0004	1.54	1	----	----	----
No. 9	1°55′ N.	120°14′ W.	10-26-52	0105	3.05	----	----	----	----
No. 10	1°02′ N.	120°17′ W.	10-27-52	0111	1.46	----	----	----	----
No. 11	0°39′ N.	120°14′ W.	10-28-52	0115	2.62	----	----	----	----
No. 13	1°04′ S.	120°07′ W.	10-28-52	2309	1.62	----	----	----	----
No. 15	3°06′ S.	120°10′ W.	10-29-52	2310	1.36	----	----	----	----
No. 17	4°50′ S.	120°21′ W.	10-31-52	1206	0.77	----	----	----	----
No. 19	6°37′ S.	120°24′ W.	10-31-52	2307	1.37	----	----	----	----
No. 21	8°40′ S.	120°35′ W.	11- 1-52	2308	0.88	----	1	----	----
No. 24	4°12′ S.	130°14′ W.	11- 5-52	2311	0.87	----	1	----	----
No. 26	2°15′ S.	130°11′ W.	11- 6-52	2310	1.12	----	----	----	----
No. 28	0°27′ S.	130°09′ W.	11- 7-52	2310	1.31	----	----	----	----
No. 30	1°10′ N.	130°08′ W.	11- 9-52	0103	2.33	----	----	----	----
No. 31	1°42′ N.	130°22′ W.	11- 9-52	2329	1.31	----	----	1	----
No. 32	3°15′ N.	130°14′ W.	11-11-52	0005	1.40	----	----	----	2
No. 33	4°37′ N.	130°26′ W.	11-12-52	0015	0.71	----	----	----	----
No. 34	5°42′ N.	130°50′ W.	11-12-52	2308	0.87	----	----	----	----
No. 36	7°56′ N.	131°11′ W.	11-14-52	0002	1.18	----	----	----	----
No. 37	9°12′ N.	131°24′ W.	11-15-52	0103	0.60	----	----	----	----

[1] +8 zone time on all stations.

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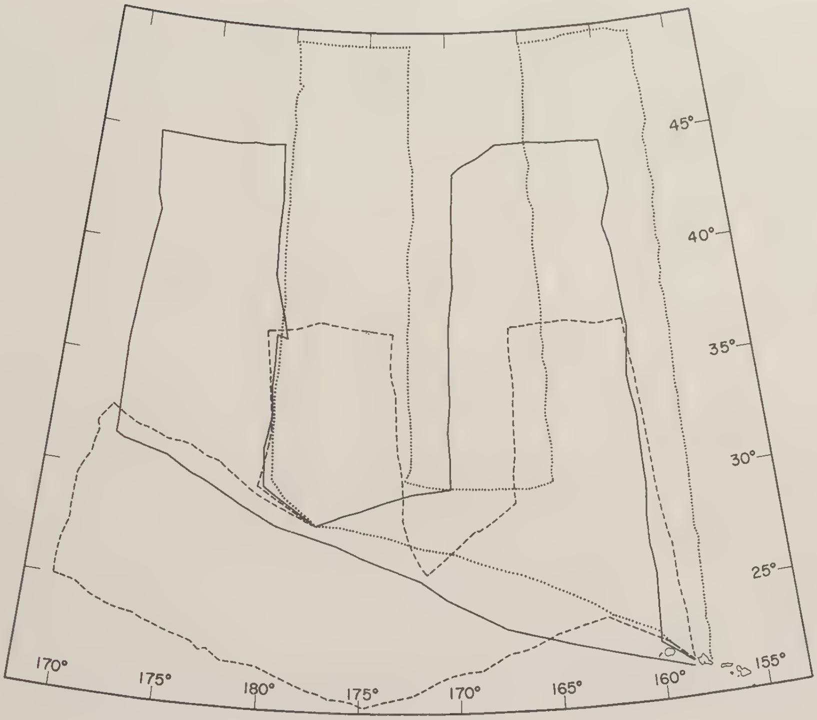

OCEANOGRAPHIC OBSERVATIONS IN THE CENTRAL NORTH PACIFIC, SEPTEMBER 1954 - AUGUST 1955

By

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ABSTRACT

This report presents the results of three oceanographic cruises to the temperate central North Pacific by the research vessels Charles H. Gilbert and Hugh M. Smith of the Pacific Oceanic Fishery Investigations, U. S. Fish and Wildlife Service. The cruises were confined to the area bounded roughly by 157°30'W. and 170°E. longitude and 20°N. and 49°30'N. latitude. The report includes the observed and interpolated data for the first two cruises and the plots of the various field, such as salinity and dissolved oxygen, for all three cruises.

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Casts with 13 Nansen bottles were made at all stations. The bottle intervals in the upper 200 meters were determined from the vertical temperature structure as indicated by the bathythermogram taken at the station. Below 200 meters they were placed at standard depths (U. S. Navy Hydrographic Office, 1955). All bottles carried two reversing thermometers; bottles 5, 7, 9, 11, and 13 carried one protected and one unprotected thermometer; all others carried two protected thermometers.

At the first 8 stations the casts were made to 1,200 meters, but after station 8 they were made to only 1,000 meters. This change in depth was necessary because of the loss of a portion of the wire cable.

At station 34 (35°45'N., 171°32'E.) the bottom three bottles of the cast (600, 800, and 1,000 m.) fouled a ridge or pinnacle. The position was on a bearing of 340°T. and a distance of 30 miles from a sea mount shown on the chart (H. O. 0528). Possibly an uncharted ridge extending out from this sea mount was fouled. Unfortunately all of the echo sounding equipment was inoperative so bottom profiles could not be obtained. A few, small, pelecypod shells and bits of well-aged coral were brought up in the thermometer frame of the 800-meter bottle.

2. Salinity samples were drawn from each Nansen bottle and returned to the POFI laboratory for analysis. Additional surface samples were taken at every third BT on the run from station 40 to Pearl Harbor. To prevent evaporation during storage, each sample was stoppered with a paraffin-impregnated cork in addition to the ordinary screw cap. The salinities of the station samples are given in the station data (table 1) and the surface salinities at the BT's are given in the last column of the BT data (table 2). The salinity profiles are shown in figures 28 to 30, the surface salinity in figure 31, and the salinity on the 25.2, 26.0, and 26.8 sigma-t surfaces in figures 32 to 34.

3. Dissolved oxygen analyses by the Winkler method were made aboard ship on samples from each depth at all oceanographic stations. The results are given in table 1. The profiles along 160°W., 170°W., and 180° longitudes are shown in figures 35 to 37. The distributions on the 25.2, 26.0, and 26.8 sigma-t surfaces are shown in figures 38 to 40.

4. Inorganic-phosphate analyses were also made aboard ship by the molybdenum-blue method (Wooster and Rakestraw 1951). Analyses were made on samples from all depths at all stations except 19 through 26. Photometer (Lumetron) failure, which could not be repaired until parts were obtained at Midway, prevented analyses at these stations. The observed values are given in table 1 and the profiles in figures 41 to 43. Adequate charts of the surface distribution and on surfaces of constant sigma-t could not be drawn because of missing data resulting from instrument failure and the omission of stations in rough weather.

5. Bathythermograph lowerings were made at all oceanographic stations and at 30-mile intervals between stations. On the run along the islands of the Hawaiian Archipelago between station 40 and Pearl Harbor the interval was shortened to 2-1/2 hours or approximately 20 miles to obtain a more detailed profile. The observations (Log Sheet B) made at the BT lowerings are summarized in table 2. Figures 13 to 20 are the surface temperature distribution and profiles drawn from the BT data.

6. Throughout the cruise a continuous record of the surface temperature was made with a recording thermograph.

7. When weather conditions permitted, Secchi disc observations (total of 12) of transparency and water color according to the Forel scale were made at all daylight oceanographic stations. These observations are recorded in the station data headings (table 1).

Secondary Missions

1. Oblique 0-100 m. zooplankton hauls of 30 minutes' duration with a 1-meter net of 30XXX silk grit gauze were made at each station. These data will be summarized in a separate report.[2]

2. From two to six lines were trolled during all daylight runs. The results have been summarized by Shomura and Otsu (1956).

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[2] "Zooplankton distribution and biological indicators related to oceanographic conditions and to albacore abundance in the central North Pacific," manuscript being prepared by E. C. Jones of Pacific Oceanic Fishery Investigations.

3. The wheel watch maintained a record of all tuna schools, bird flocks, and scattered birds and mammals sighted.

4. Synoptic weather observations, made daily at 0000, 0600, 1200, and 1800 GCT, are summarized in table 3. In addition, certain standard weather observations accompanied all BT lowerings.

   Seven storms with winds of moderate gale force (28 knots) or greater were encountered. They varied in duration from less than 6 hours to over 72 hours. The most violent occurred on October 25 at approximately 45°N., 172°E., when the barometer dropped to 986.5 mb. and the winds reached a velocity of 68 knots. The storm tracks during the months of the cruise are shown in figures 44 to 46.

5. The EDO depth sounder failed completely on September 30, so bottom profiles were obtained of only the southern part of the section along 160°W. longitude. While the instrument was functioning, some excellent recordings were made of the evening rise of the deep-scattering layers to the surface.

6. On November 3, 1954, about 6 hours were spent ashore on Laysan Island, which is a part of the Hawaiian National Wildlife Refuge. Only a few scattered Laysan albatross and small numbers of blackfooted albatross, Laysan finch, shearwater, terns, and one flock of about 50 young frigate birds were sighted on the island. There were no signs of nesting at this time. The Hawaiian monk seal population was estimated to be between 100 and 150.

Form and Location of Field Data

The following records were kept on *Charles H. Gilbert* cruise 17; they are on file at POFI except as otherwise noted:

Original oceanographic data, Log Sheet "A"
Bathythermograph Log Sheet "B" (duplicates at Scripps Institution of Oceanography)
Chemical data sheets
BT slides (Scripps Institution of Oceanography)
Thermograph records
Track charts
Deck log
Occurrence of tuna schools, birds, and aquatic mammals
Plankton log
Flowmeter and sampler calibration log
Standardized surface trolling data sheets
Scientists' log
USWB Form 1210F (original at U. S. Weather Bureau Records Center, Asheville, N. C.)
EDO depth recorder charts
Barograph records
Tuna morphometric sheets - short form

HUGH M. SMITH CRUISE 27

Itinerary

The *Smith* departed from Pearl Harbor on January 5, 1955. Engine trouble developed on January 19 at 32°30'N., 170°30'E. The vessel put into Midway Islands for repairs, arriving on January 24 and departing Midway on January 31. About 12 hours were spent on February 10 surveying the wildfowl refuge at Laysan Island. The vessel returned to Pearl Harbor on February 21, 1955. The cruise track and station positions are shown in figure 47.

Primary Missions

1. Forty-nine oceanographic stations were occupied at the positions indicated on figure 47. Casts with 13 bottles were made on all stations to approximately 1,200 m. The bottle intervals in the upper 200 meters were determined from the vertical temperature structure indicated by the bathythermogram taken at the station. Each bottle carried two protected reversing thermometers and bottles 5, 7, 9, 11, and 13 also carried an unprotected thermometer.

2. Salinity samples were drawn from each Nansen bottle and returned to the POFI laboratory for analysis. In addition, at every second BT between 32°30'N., 170°30'E. and Midway Islands, surface samples were taken. The salinity of the station samples is given in the station data (table 4) and at the BT's in the last column of the BT data, table 5. The salinity profiles are presented in figures 78 to 82 and the distribution at the surface and on the 25.2, 26.0, and 26.8 sigma-t surfaces in figures 83 to 86.

3. Dissolved oxygen analyses using the Winkler method were made aboard ship on samples from each depth. The observed values are given in table 4, the profiles in figures 87 to 91, and the distribution on the 25.2, 26.0, and 26.8 sigma-t surfaces in figures 92 to 94.

4. Inorganic phosphate analyses were also made aboard ship on samples from each depth at all stations. Additional surface samples

were collected and analyzed on the run between 32°30'N., 170°30'E. and Midway Islands. The results are tabulated in the station data, table 4, and BT log sheet summaries, table 5. The profiles are given in figures 95 to 99 and the surface distribution in figure 100. Only the plots on the 26.0 and 26.8 sigma-t surfaces were plotted (figs. 101 and 102), since the range on the 25.2 sigma-t surface was only from 0.19 to 0.40 µg at./L.

5. Bathythermograph lowerings were made at each oceanographic station and at approximately 30-mile intervals between stations. The observations (Log Sheet "B") are summarized in table 5; figures 63 to 68 show the temperature profiles and surface temperature distribution drawn from the BT data.

6. A continuous record of the surface water temperature was made by means of a recording thermograph.

7. A 30-minute, 0-100 m. oblique plankton haul with a 1-meter net of 30XXX silk grit gauze was made at each oceanographic station except at station 14. This haul was omitted because of rough seas. The plankton data will be summarized in another report (Jones MS.).

8. Twenty-six collections were made with 6- and 10-foot Isaacs-Kidd mid-water trawls. An analysis of these collections will be presented in a separate report.

9. Night-light collections were attempted at oceanographic stations 61 and 66. At station 61 only 12 sauries were taken and at station 66 there was no catch.

Secondary Missions

1. Five lines were trolled during daylight hours. The results have been summarized by Shomura and Otsu (1956).

2. The wheel watch maintained a record of all tuna schools, bird flocks, and scattered birds and mammals sighted.

3. Synoptic weather observations were made daily at 0000, 0600, 1200, and 1800 GCT; the resulting data are summarized in table 6. In addition, certain standard weather observations accompanied all BT lowerings. The anemometer failed on February 8, 1955, and the winds recorded after 1640 GCT on that date were estimated. Five storms with winds of moderate gale force (28 knots) or greater were encountered. They varied in duration from 4 to 21 hours. The storm tracks during the months of the cruise are shown in figures 103 and 104.

4. A bait-fish survey was conducted on Midway and Laysan Islands. The results will be summarized in a separate report.

5. A bird count was conducted on Laysan Island with emphasis on the rare Laysan Duck. These data will also be covered in a separate report.

6. A count was made of the Hawaiian monk seals on Midway Islands and on Laysan Island. A total of 26 seals were counted on Midway Islands. On Laysan Island there were 105, consisting of 67 adults (200 lbs. or over), 19 juveniles (50-200 lbs.) and 19 pups (about 25 lbs.). One of the pups was born on the day the survey was made (February 10, 1955).

Form and Location of Field Data

The following records were kept on Hugh M. Smith cruise 27; they are on file at POFI except as otherwise noted:

- Barograph records
- Bathythermograph Log Sheet "B" (duplicates at Scripps Institution of Oceanography)
- Bathythermograph slides (Scripps Institution of Oceanography)
- Chemical data sheets
- Deck log
- Flowmeter and sampler calibration log
- Light fishing station log
- Occurrence of tuna schools, birds, and aquatic mammals
- Original oceanographic data, Log Sheet "A"
- Plankton log
- Scientists' log
- Tuna morphometric sheets - short form
- Standardized surface trolling data sheets
- Thermograph records
- Thermometer arrangement forms
- Track charts
- Trawling log
- USWB Form 1210F (original at U.S. Weather Bureau Records Center, Asheville, N.C.)

HUGH M. SMITH CRUISE 30

The description of the cruise, methods, and the observed data have already been published (McGary, Jones, and Austin 1956). Only the processed data, consisting largely of profiles and distribution of the various fields at the sea surface and on surfaces of constant thermosteric anomaly, are included in this report (figs. 105 through 144).

LABORATORY METHODS AND TECHNIQUES

Most of the methods used in the chemical analyses and in preparing the graphs of the distribution of the various fields have been described in previous reports (Cromwell 1951, Stroup 1954, McGary and Stroup 1956, McGary, Jones, and Austin 1956, King et al. 1957). Only the procedures that varied to some degree from those of previous reports will be discussed.

The salinity determinations were made by a new modification of Fajan's adsorption indicator method developed by Van Landingham (1957) and adapted to Knudsen's techniques for sea water. It gives a much sharper end point than the potassium chromate indicator and permits a routine precision of about 0.03 percent.

The relative density profiles and surfaces for Charles H. Gilbert cruise 17 (figs. 21-24) and Hugh M. Smith cruise 27 (figs. 74-77) are expressed in the terms of sigma-t (LaFond 1951). Following the suggestion of Montgomery and Wooster (1954), the use of sigma-t was replaced with the thermosteric anomaly (δ_t) in the plots of Hugh M. Smith cruise 30 (figs. 120-122). The latter consists of the salinity and temperature terms of the anomaly of specific volume, i. e.

$$\delta_t = \delta_s + \delta_t + \delta_{st}$$

Montgomery and Wooster defined thermosteric anomaly as "the anomaly of specific volume (steric anomaly) that would be attained if the water were changed isothermally to a standard pressure of one atmosphere" and assigned the dimensions centiliters per ton (cl./ton). The advantage of the thermosteric anomaly is that, if extreme precision is not desired, it can be used for graphical hydrostatic computations for the upper 500-1,000 m. Montgomery and Wooster found that, in the equatorial Pacific, the range of the pressure terms amounted to only 6 cl./ton, which is 3 cm. in thickness for a 500-db. layer.

Two different methods were also employed in making the hydrostatic calculations. Those for Charles H. Gilbert cruise 17 (figs. 2-4 and 8-12) and for Hugh M. Smith 27 (figs. 48-52 and 58-62) were calculated from the equations developed by Ekman in the manner described by LaFond (1951), whereas those for Hugh M. Smith cruise 30 (figs. 106-109 and 114-118) were computed by a graphical method developed by Klein (MS.).[3]

The zonal (east-west) components of the geostrophic currents were computed and contoured for all three cruises (figs. 5-7, 53-57, and 110-113). This was done to permit future calculations of the volume transport through the upper 1,000 m. of each section. The currents were computed by the formulae derived by Sandstrom and Helland-Hansen (LaFond 1951, p. 17, and Cromwell 1951). Briefly, the procedure was to compute the mean current for each degree of latitude at each depth by using the dynamic heights from the isobaric surface profiles. The values were then plotted at the mid-point of each degree of latitude and at the proper depth. The velocity field was then contoured assuming that the computed values represented the velocity at each point.

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[3] "A new method for processing oceanographic data," unpublished manuscript by Hans Klein, Scripps Institution of Oceanography.

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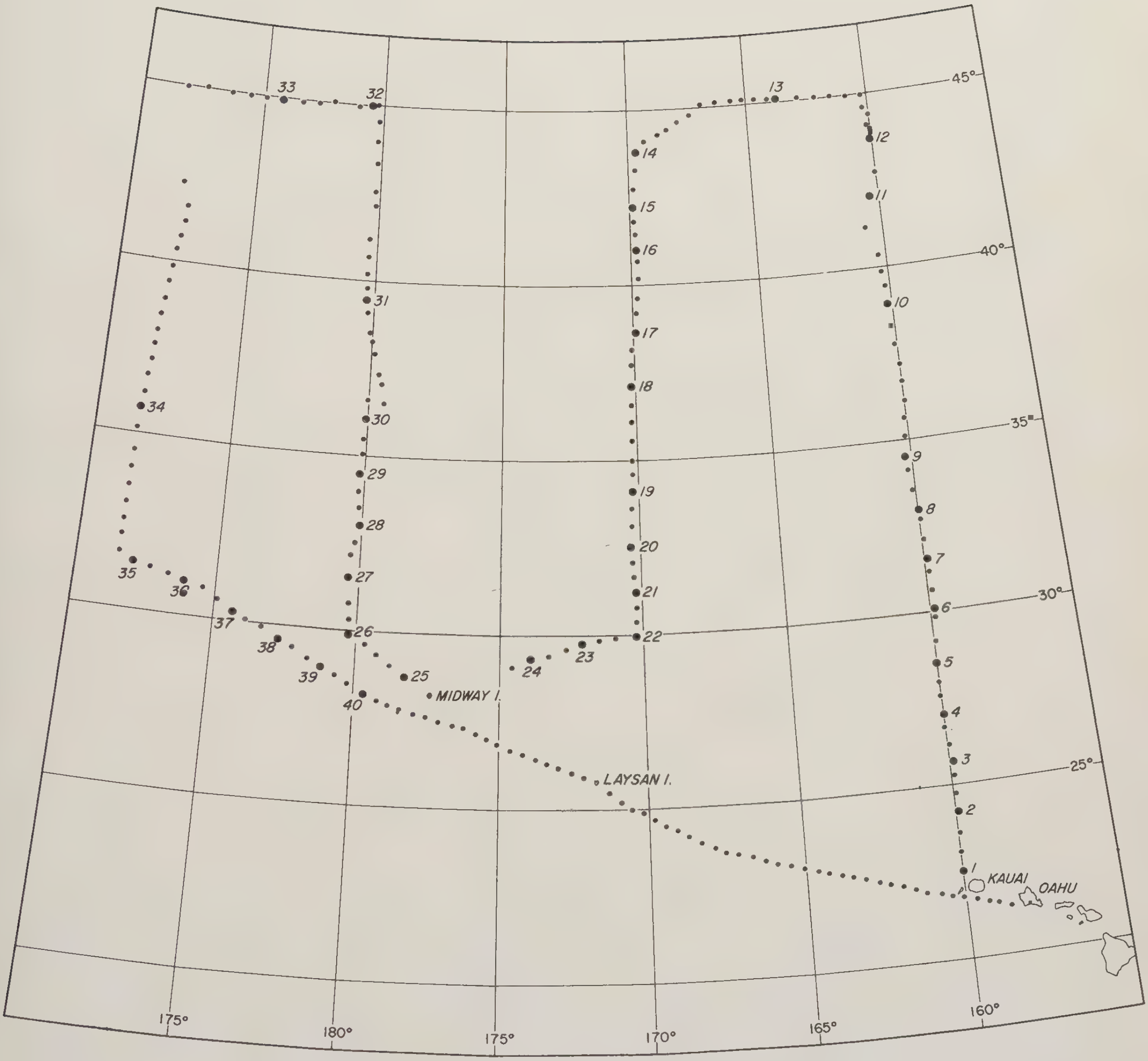
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MIDWAY I.
LAYSAN I.
KAUAI
OAHU

Figure 1.--Oceanographic station positions, Charles H. Gilbert cruise 17, September-November 1954. Large numbered dots indicate oceanographic stations; small dots indicate positions of BT lowerings between stations.

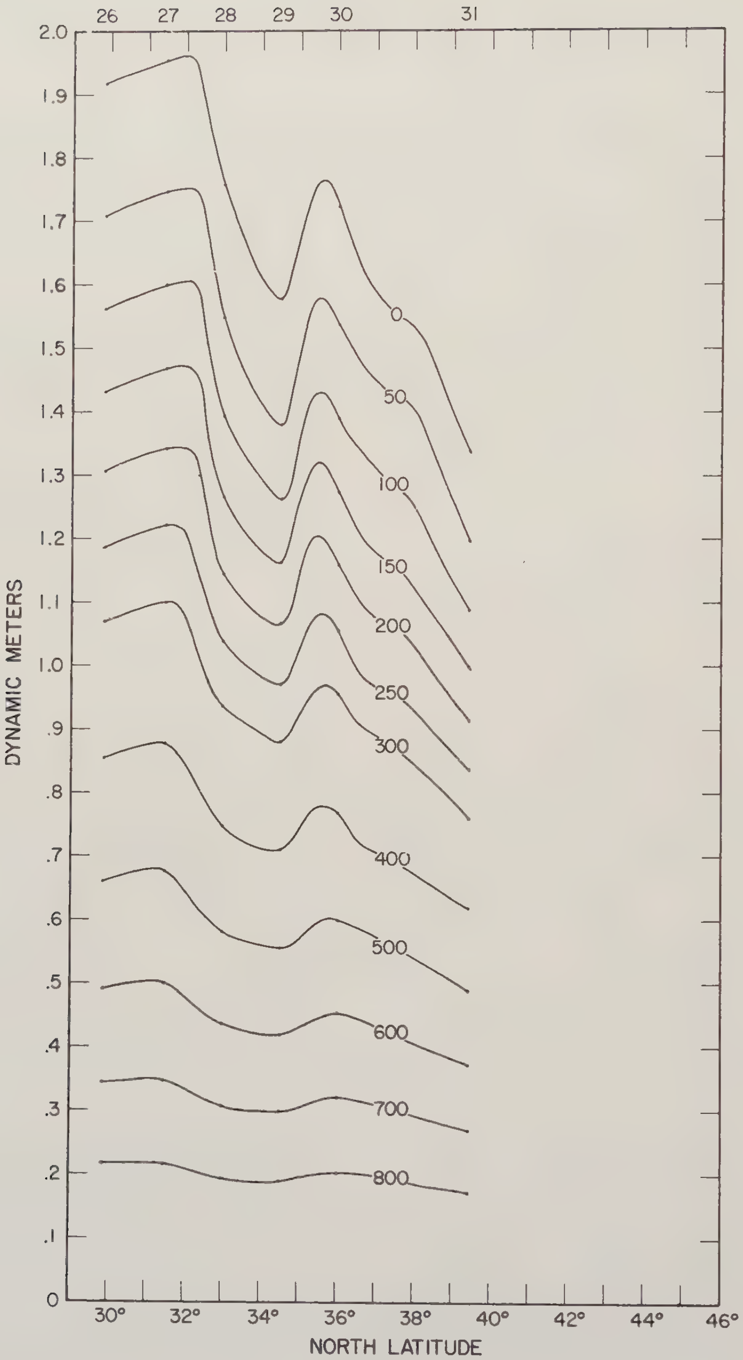


Figure 2.--Smoothed geopotential anomaly of the isobaric surfaces relative to the 1,000-db. surface along the 180th meridian; Charles H. Gilbert cruise 17, stations 26-31, September-November 1954. Points represent computed values.

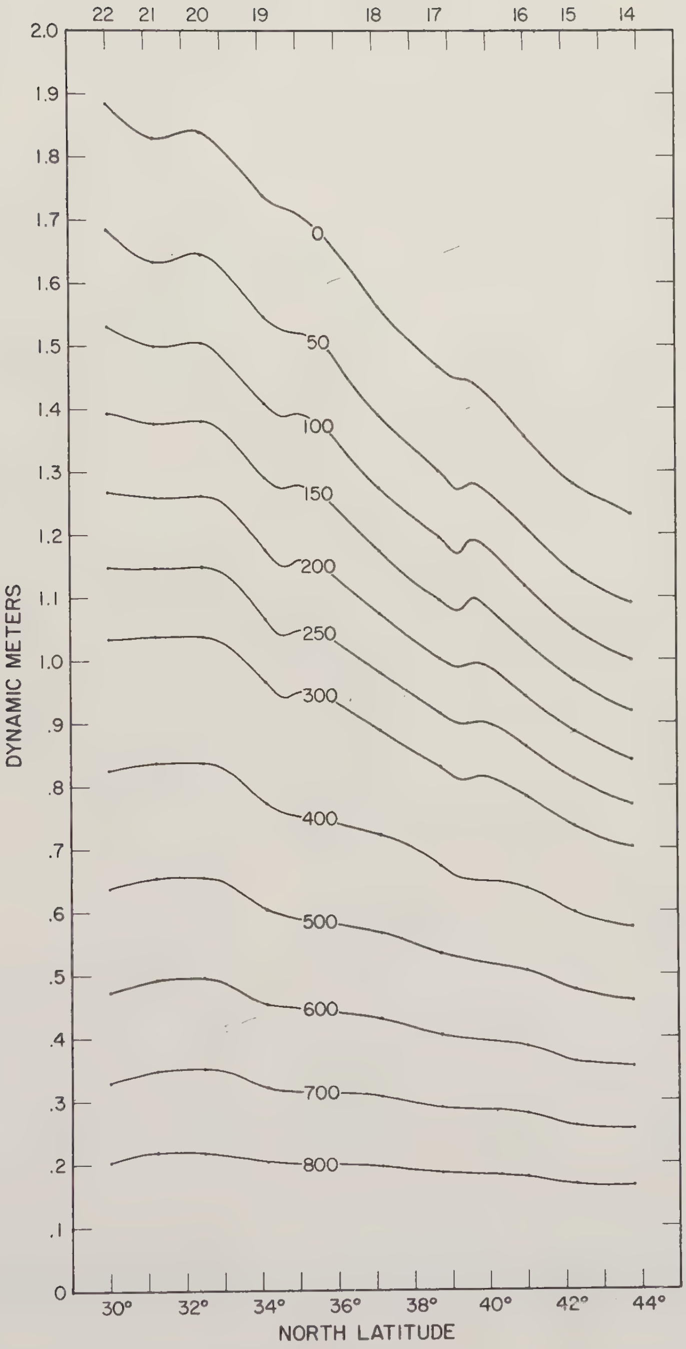


Figure 3.--Smoothed geopotential anomaly of the isobaric surfaces relative to the 1,000-db. surface along 170°W. longitude; *Charles H. Gilbert* cruise 17, stations 14-22, September-November 1954. Points represent computed values.

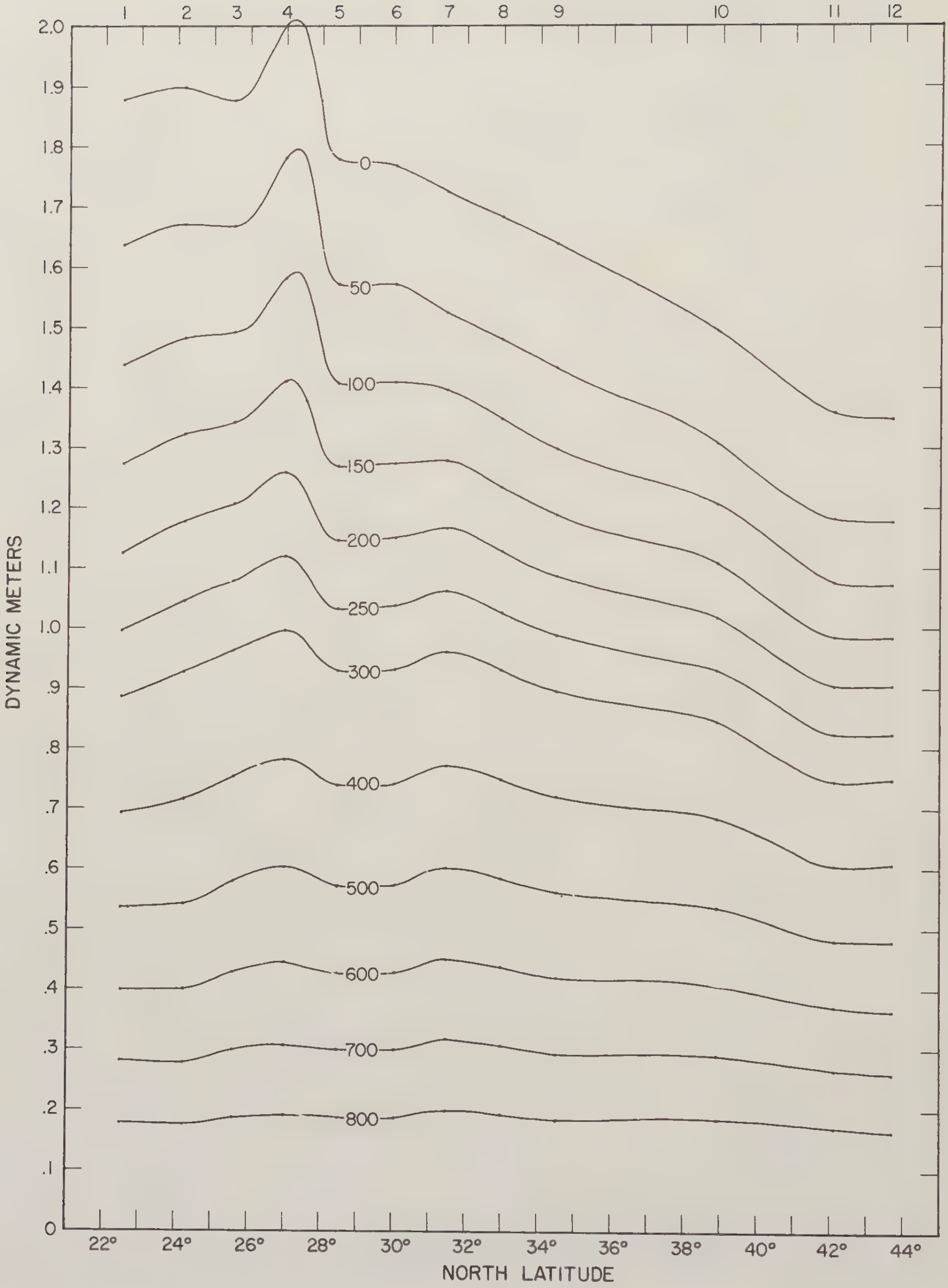


Figure 4.--Smoothed geopotential anomaly of the isobaric surfaces relative to the 1,000-db. surface along 160° W. longitude; Charles H. Gilbert cruise 17, stations 1-12, September-November 1954. Points represent computed values.

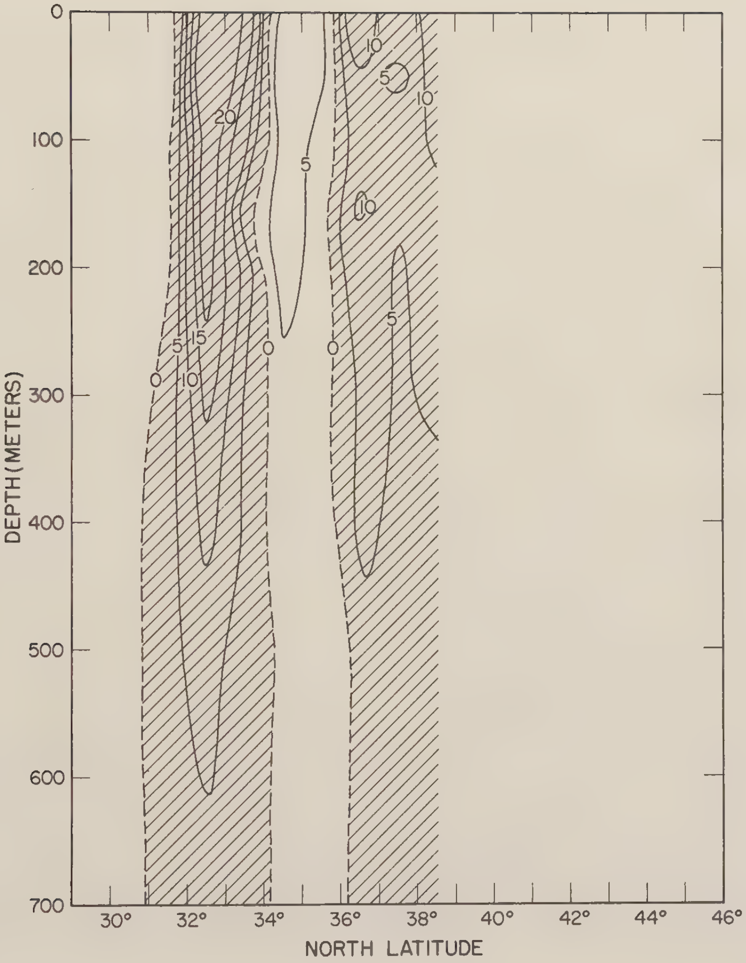


Figure 5.--Zonal components of the geostrophic currents in cm. per second across the 180th meridian; Charles H. Gilbert cruise 17, September-November 1954. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

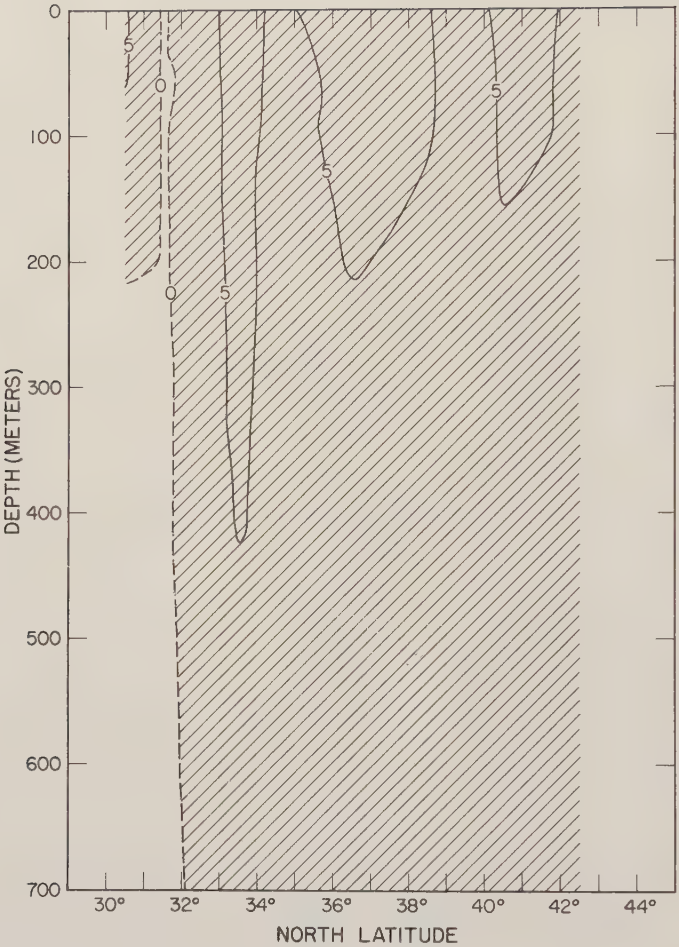


Figure 6.--Zonal components of the geostrophic currents in cm. per second across 170° W. longitude; Charles H. Gilbert cruise 17, September-November 1954. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

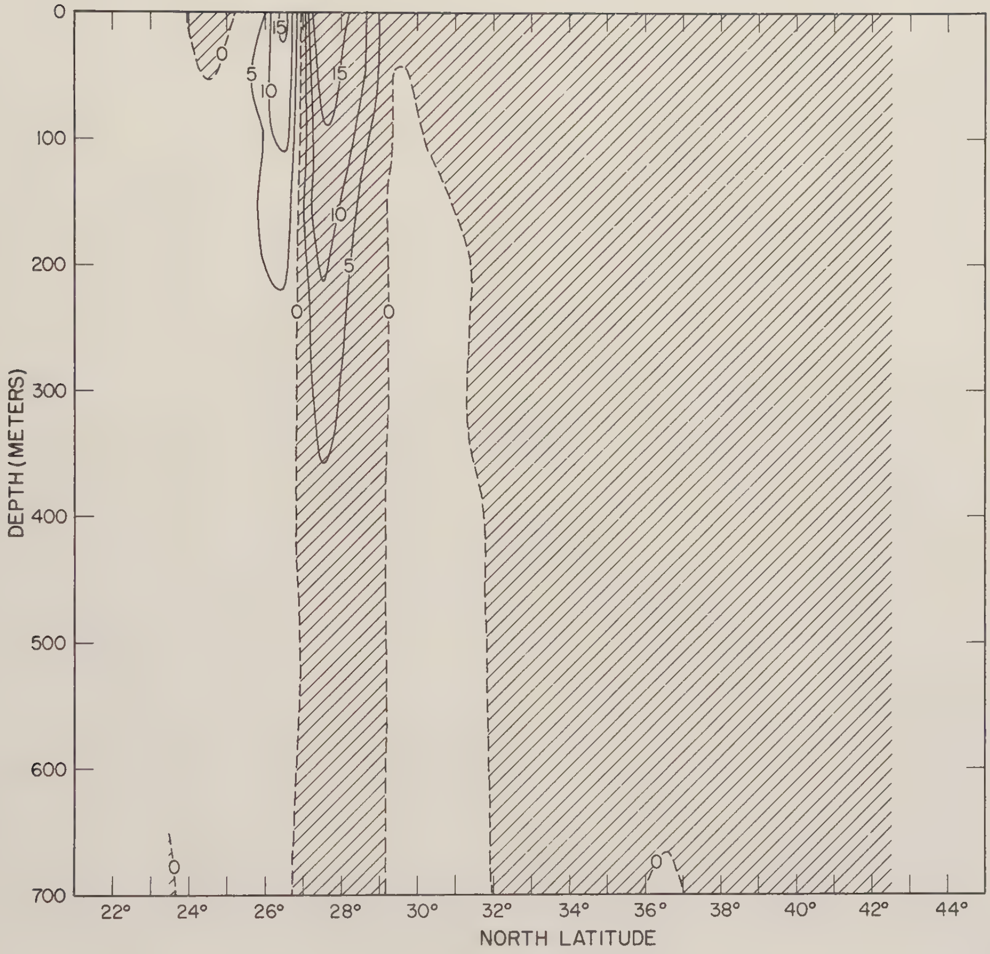
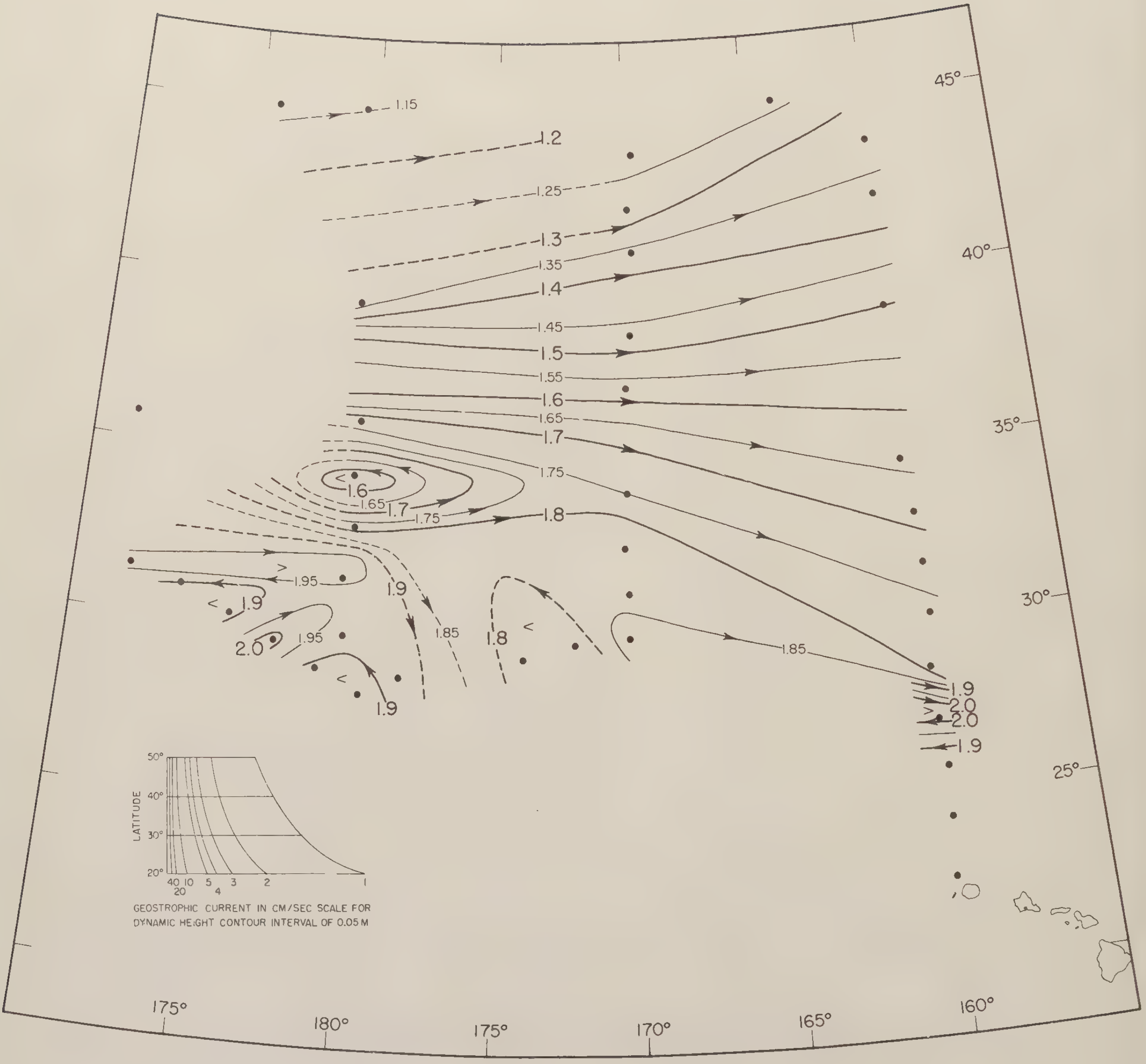


Figure 7.--Zonal components of the geostrophic currents in cm. per second across 160° W. longitude; Charles H. Gilbert cruise 17, September-November 1954. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.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1.95
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30°
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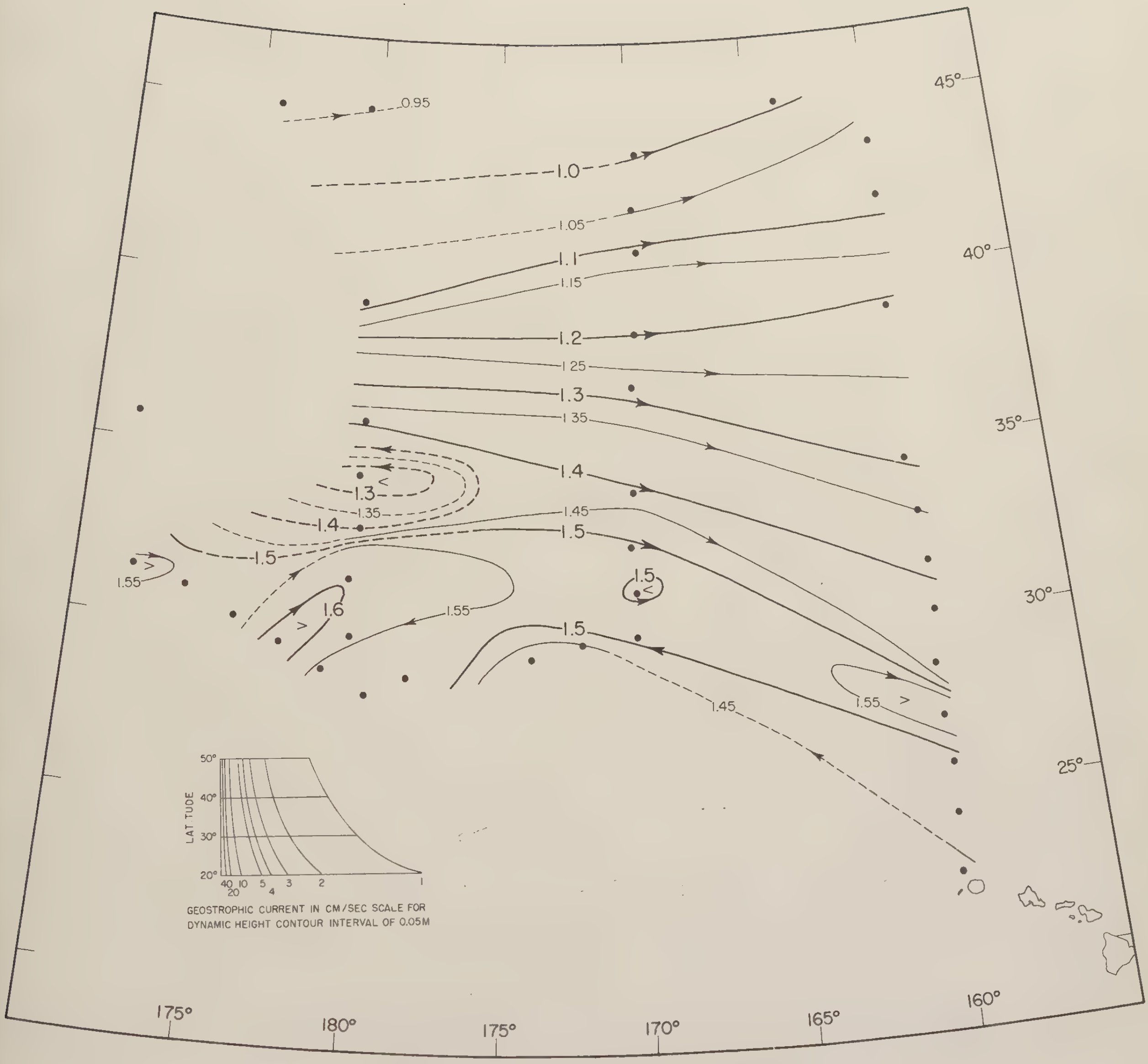
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 8.--Anomaly of the geopotential topography of the sea surface in dynamic meters relative to the 1,000-db. surface; Charles H. Gilbert cruise 17, September-November 1954. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.



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1.55
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1.5
1.55
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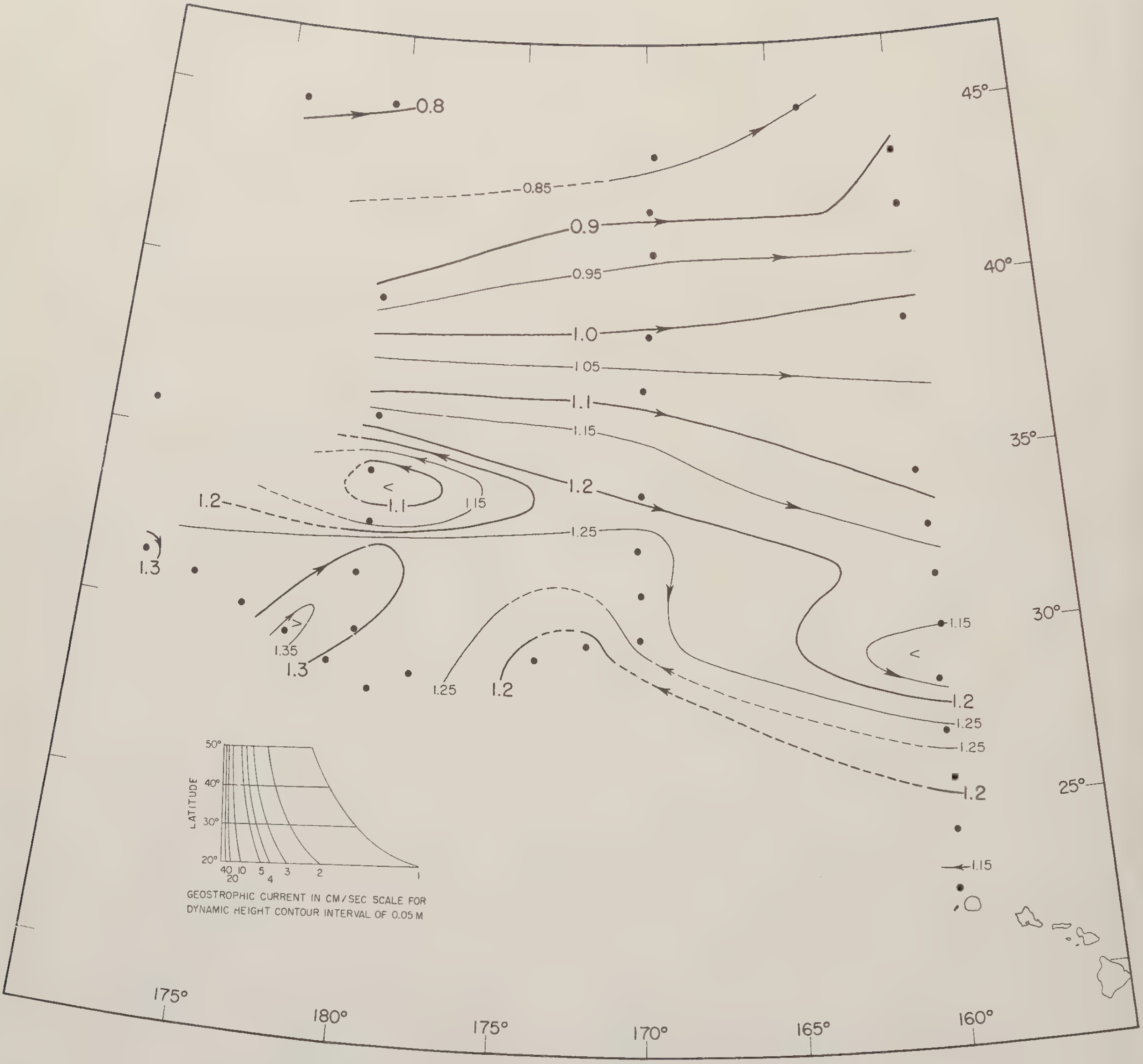
1.5
1.45
1.55
50°
40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05M

Figure 9.--Anonaly of the geopotential topography of the 100-db. surface in dynamic meters relative to the 1000-db. surface; Charles H. Gilbert cruise 17, September-November 1954. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.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1.25
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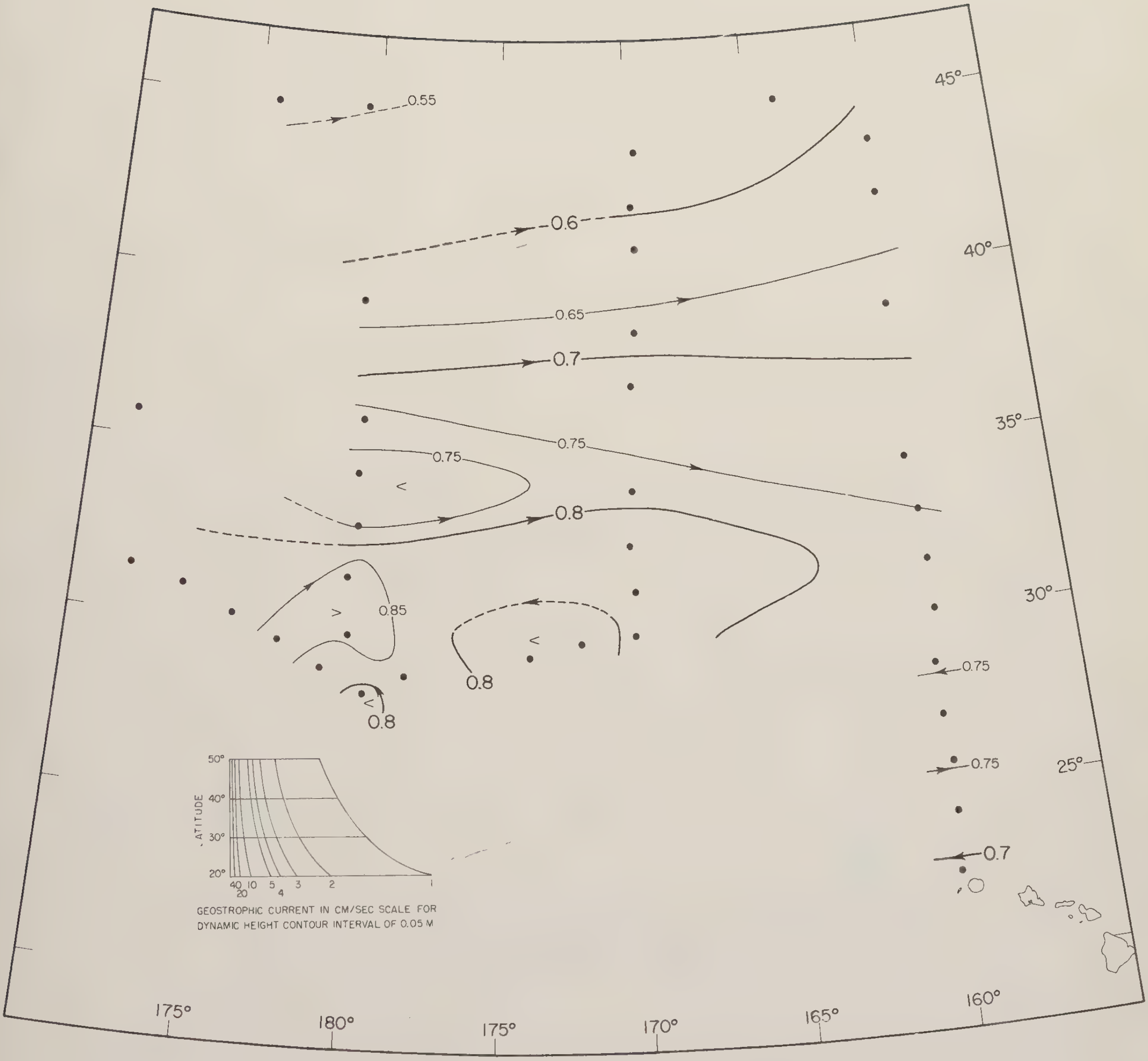
1.15
45°
40°
35°
30°
25°
175°
180°
175°
170°
165°
160°
50°
40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 10.--Anomaly of the geopotential topography of the 200-db. surface in dynamic meters relative to the 1000-db. surface; Charles H. Gilbert cruise 17, September-November 1954. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.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40 10 5 3 2 1
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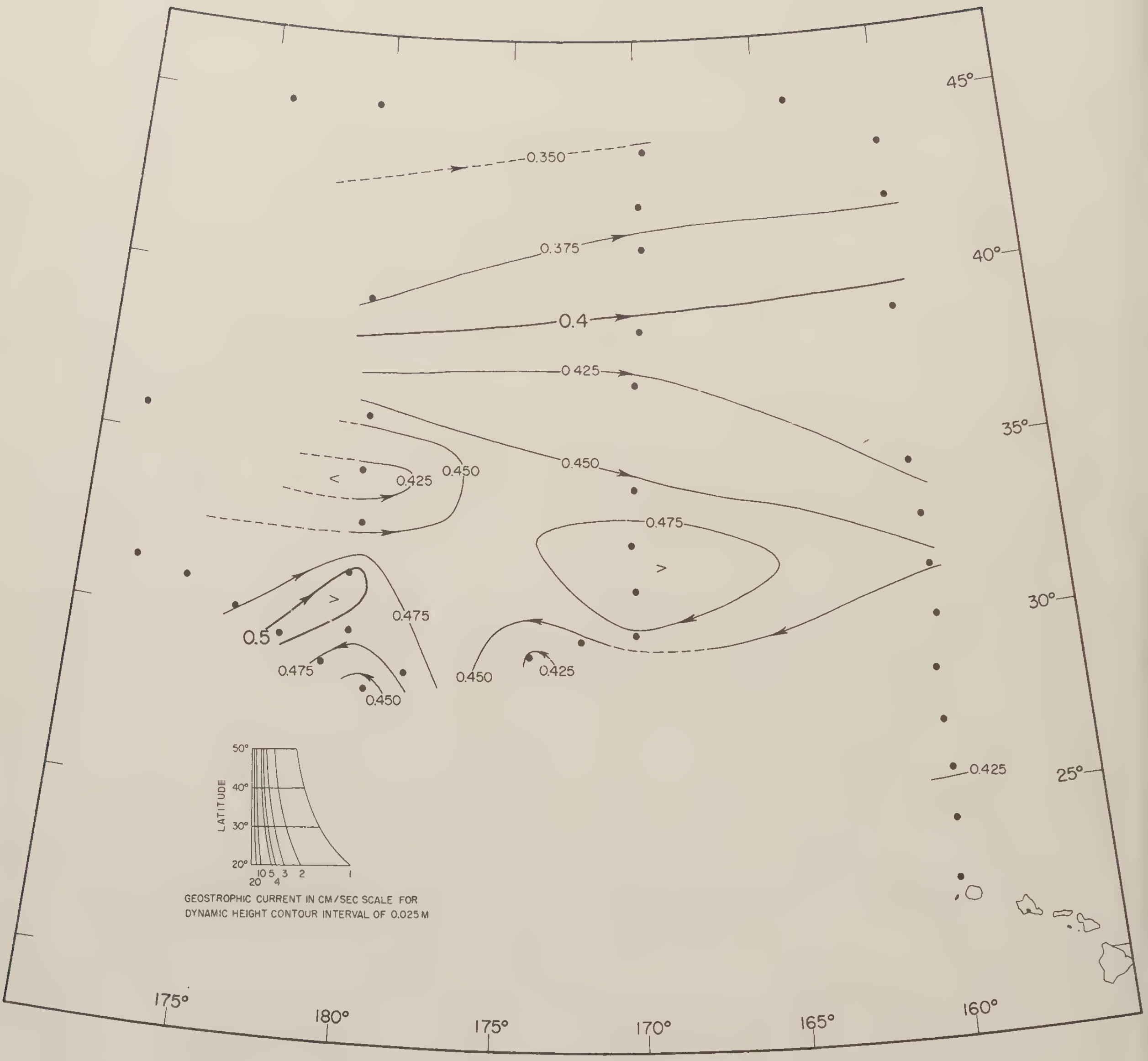
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 11.--Anomaly of the geopotential topography of the 400-db. surface in dynamic meters relative to the 1000-db. surface; Charles H. Gilbert cruise 17, September-November 1954. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.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0.425
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50°
40°
30°
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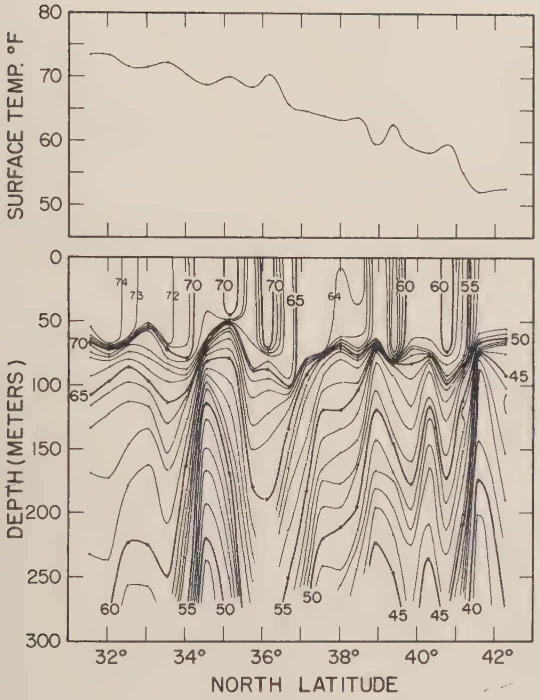
LATITUDE
10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.025 M
175°
180°
175°
170°
165°
160°

Figure 12.--Anomaly of the geopotential topography of the 600-db. surface in dynamic meters relative to the 1000-db. surface; *Charles H. Gilbert* cruise 17, September-November 1954. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.025 m.



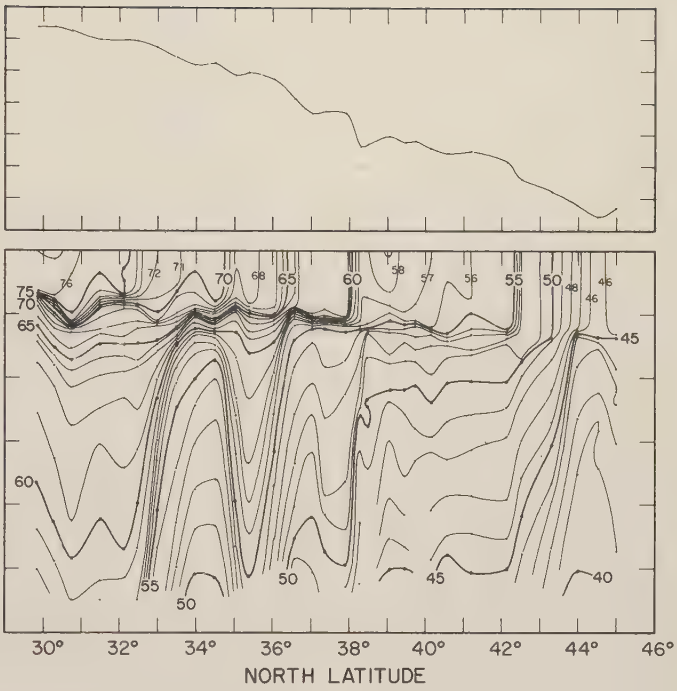
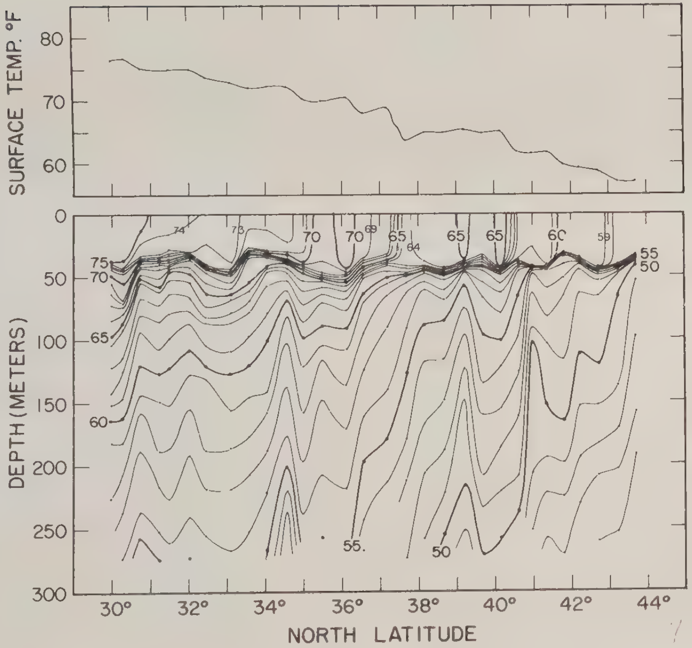


Figure 13. --Surface (bucket) temperature (upper panel) and temperature-depth section (lower panel) in degrees Fahrenheit along 172°E. longitude from BT observations; Charles H. Gilbert cruise 17, September-November 1954. Small dashes indicate the depth of lowering. Contour interval 1°F.

Figure 14. --Same along the 180th meridian.



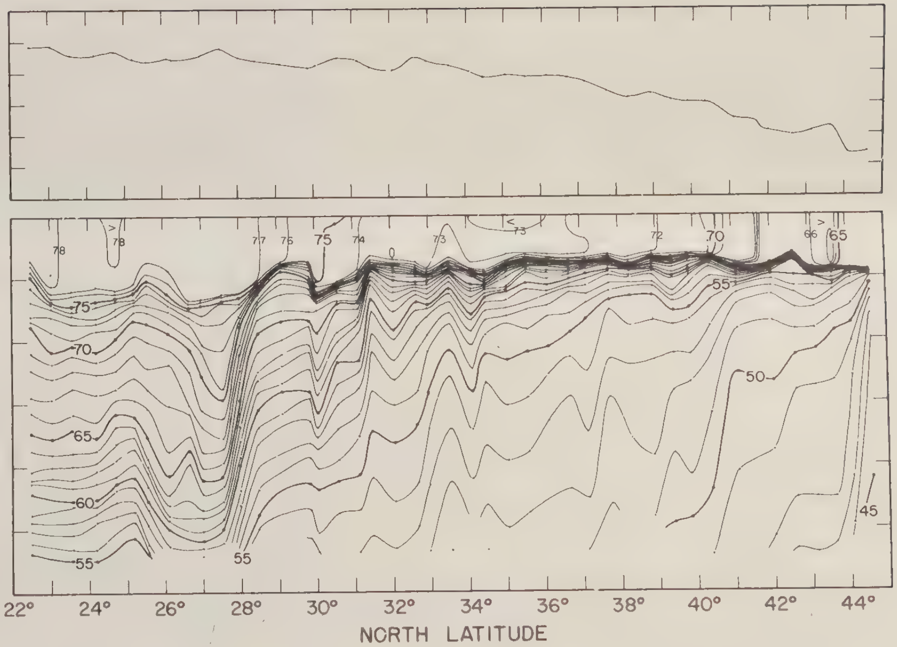
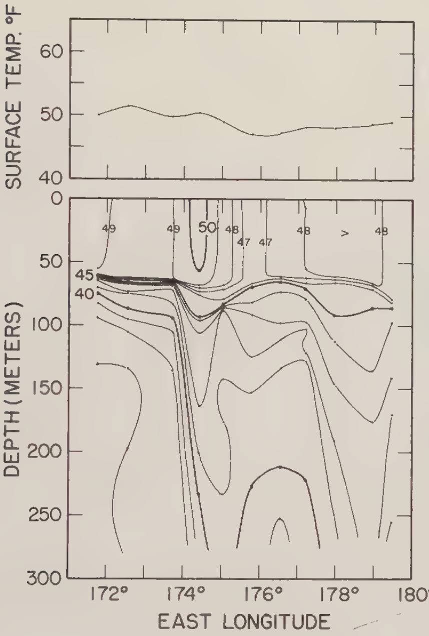


Figure 15.--Surface (bucket) temperature (upper panel) and temperature-depth section (lower panel) in degrees Fahrenheit along 170°W. longitude from BT observations; Charles H. Gilbert cruise 17, September-November 1954. Small dashes indicate the depth of lowering. Contour interval 1°F.

Figure 16.--Same along 160°W. longitude.



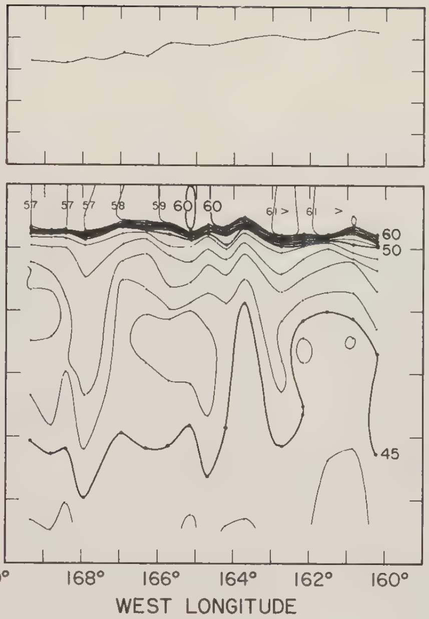


Figure 17.--Surface (bucket) temperature (upper panel) and temperature-depth section (lower panel) in degrees Fahrenheit along 45°N. latitude between 172°E. and the 180th meridian from BT observations (lower panel); Charles H. Gilbert cruise 17, September-November 1954.

Figure 18.--Same along 45°N. between 160° and 170°W. longitude.

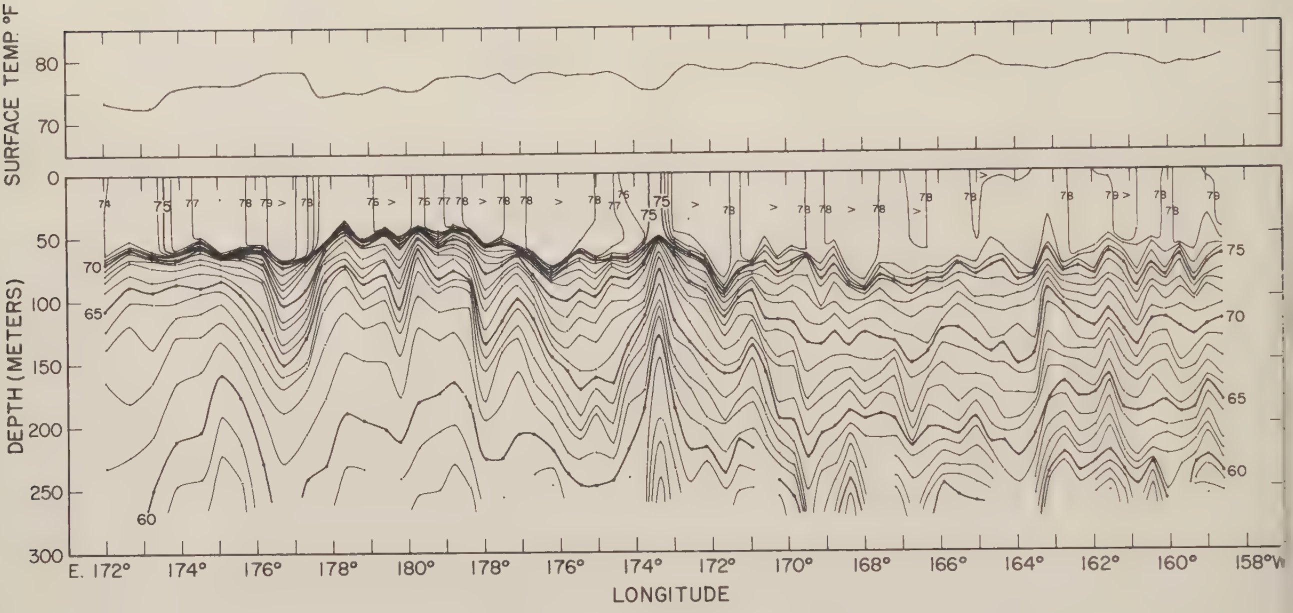


Figure 19.--Surface (bucket) temperatures (upper panel) and temperature-depth section (lower panel) in degrees Fahrenheit from 31°23'N., 172°E. to 21°23'N., 158°35'W. from BT observations; *Charles H. Gilbert* cruise 17, September-November 1954. Contour interval 1°F.

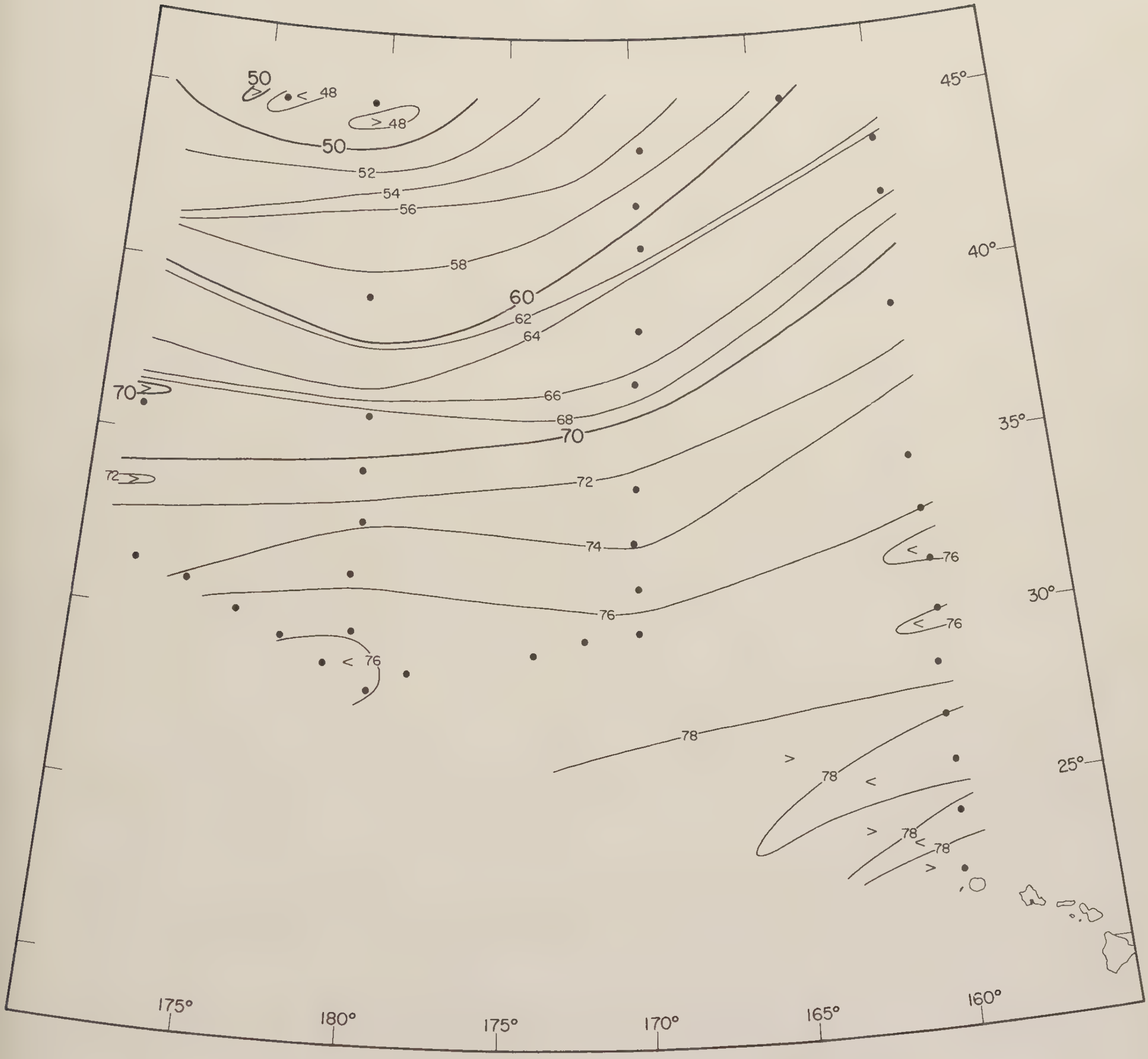

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Figure 20. --Surface (bucket) temperatures in degrees Fahrenheit; Charles H. Gilbert cruise 17, September-November 1954. Contour interval 2°F.

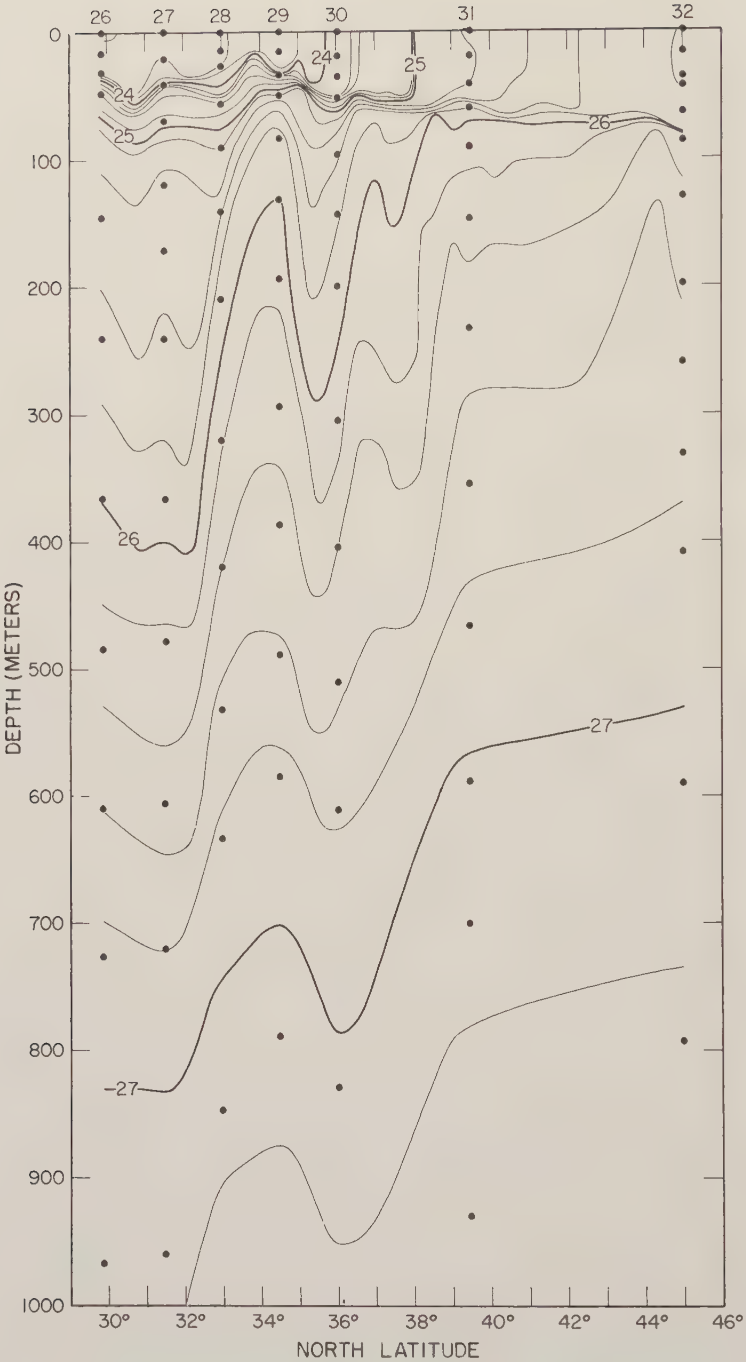

Figure 21.--Vertical section of sigma-t along the 180th meridian; Charles H. Gilbert cruise 17, stations 26-32, September-November 1954. Contour interval 0.2. Points indicate observed values.

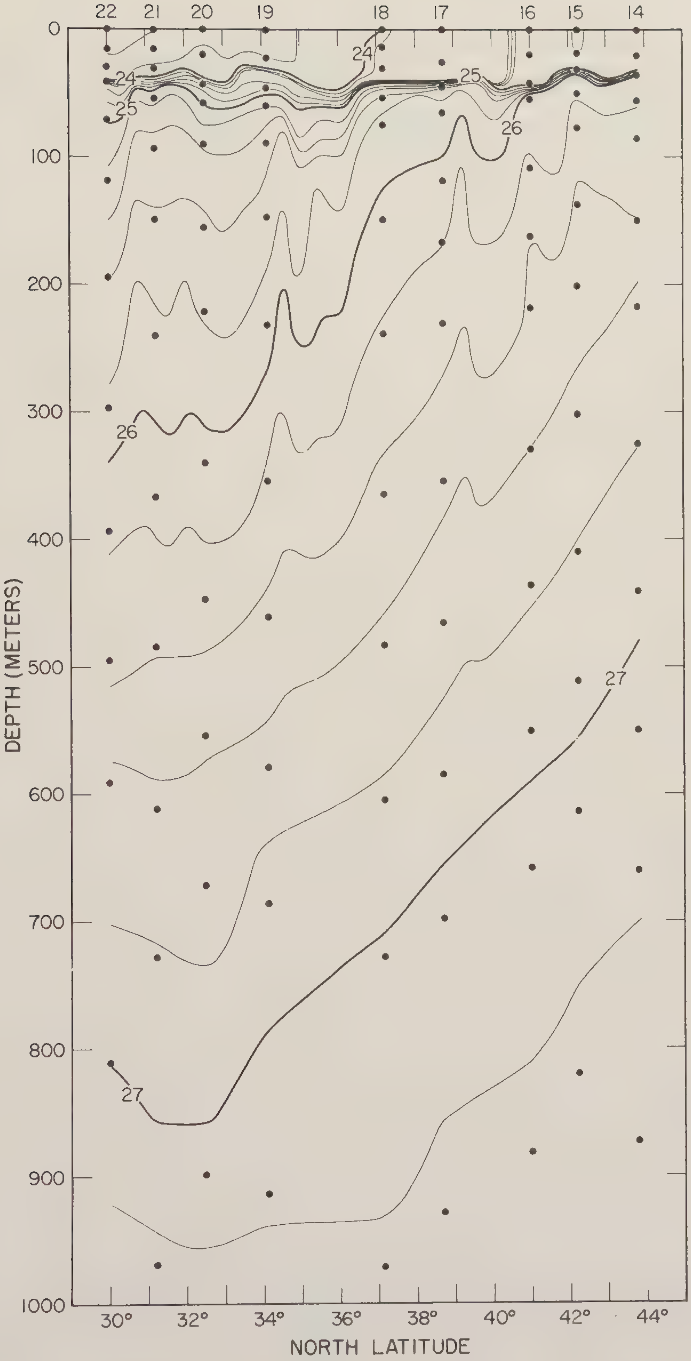

Figure 22.--Vertical section of sigma-t along 170°W. longitude; Charles H. Gilbert cruise 17, stations 14-22, September-November 1954. Contour interval 0.2. Points indicate observed values.

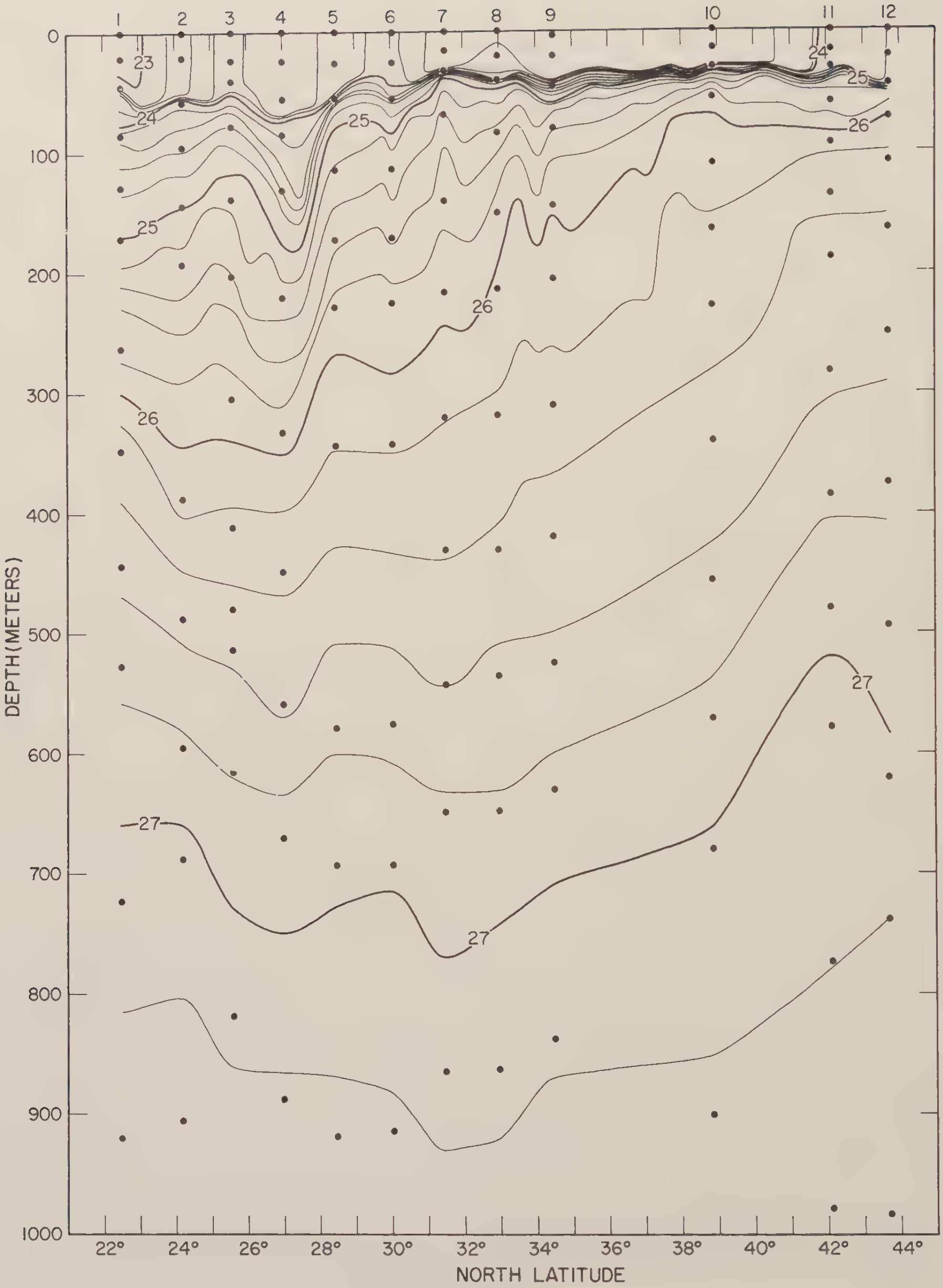

Figure 23.--Vertical section of sigma-t along 160°W. longitude; Charles H. Gilbert cruise 17, stations 1-12, September-November 1954. Contour interval 0.2. Points indicate observed values.

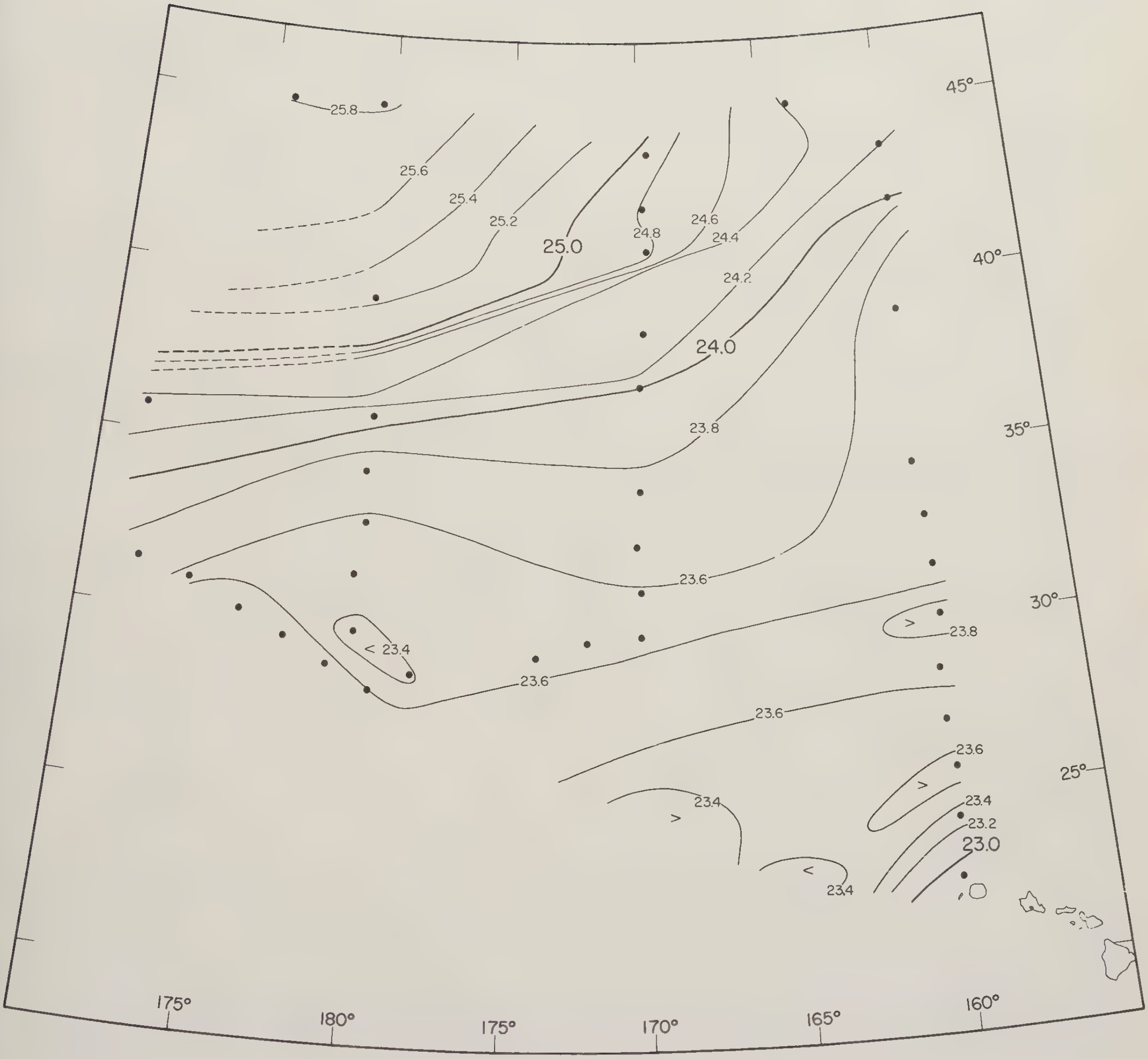
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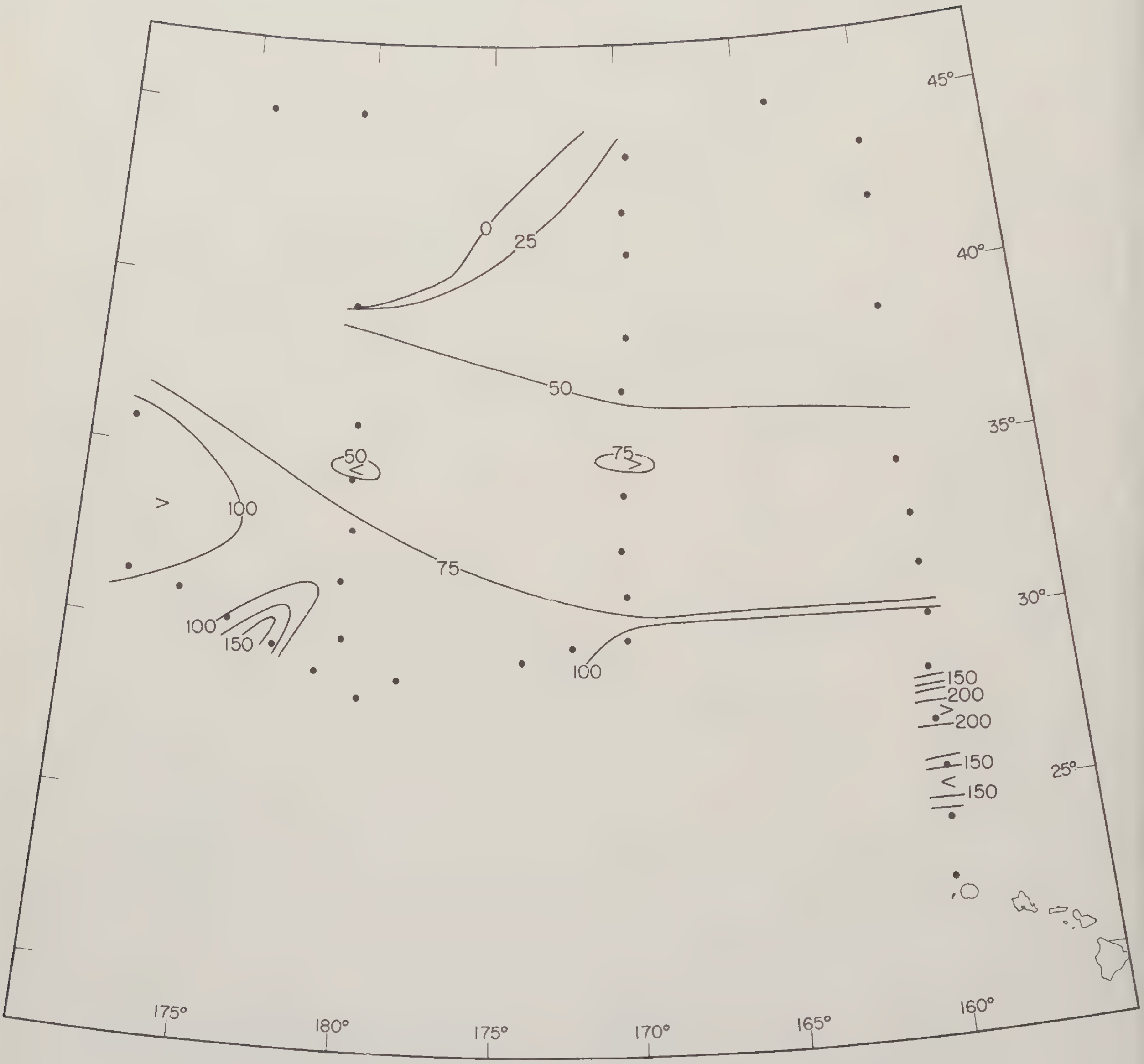
Figure 24.--Surface sigma-t, Charles H. Gilbert cruise 17, September-November 1954. Contour interval 0.2. Dots indicate station positions.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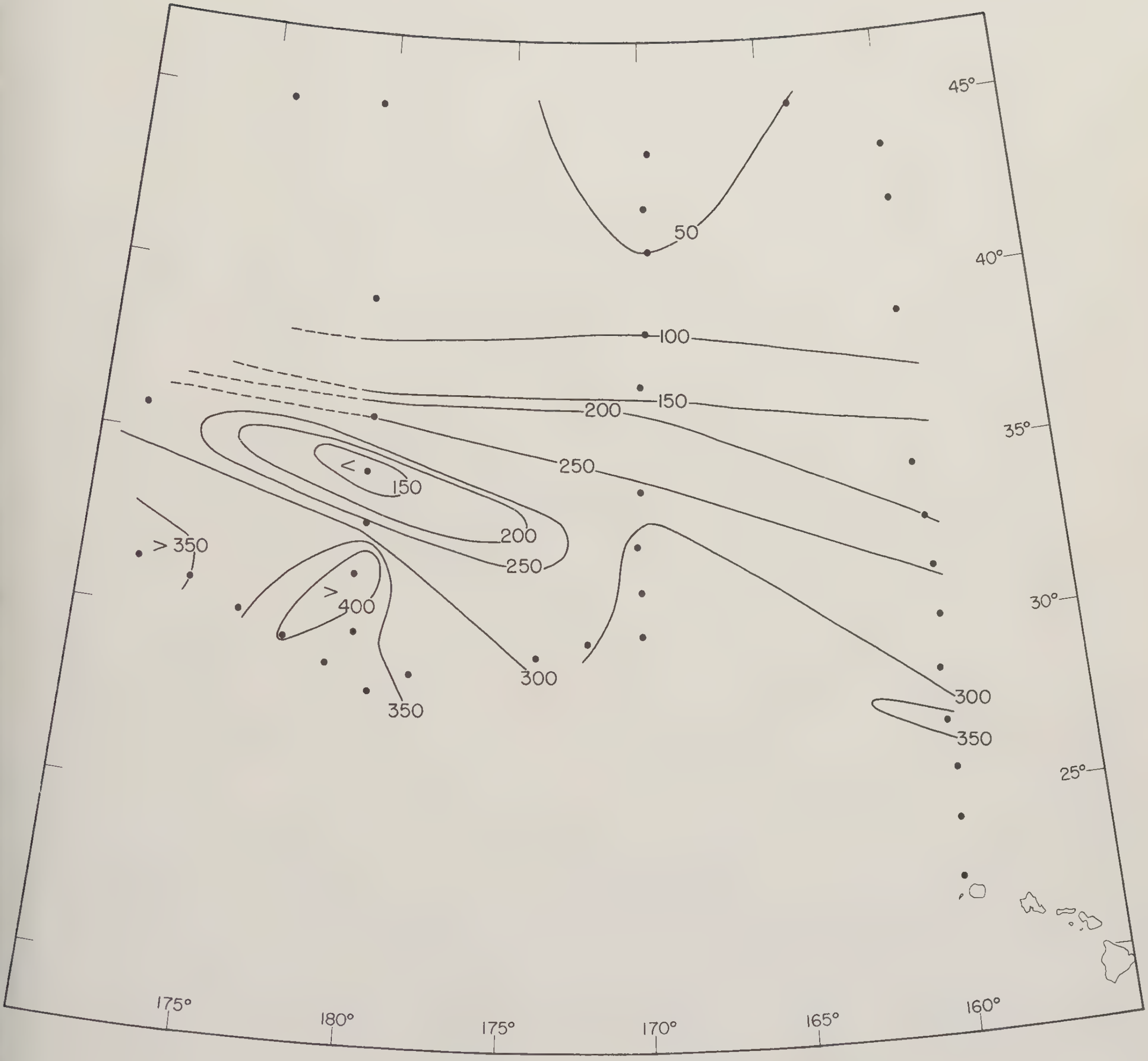
160°

Figure 25.--Depth of the 25.2 sigma-t surface in meters, *Charles H. Gilbert* cruise 17, September-November 1954. Contour interval 25 m. Dots indicate station positions.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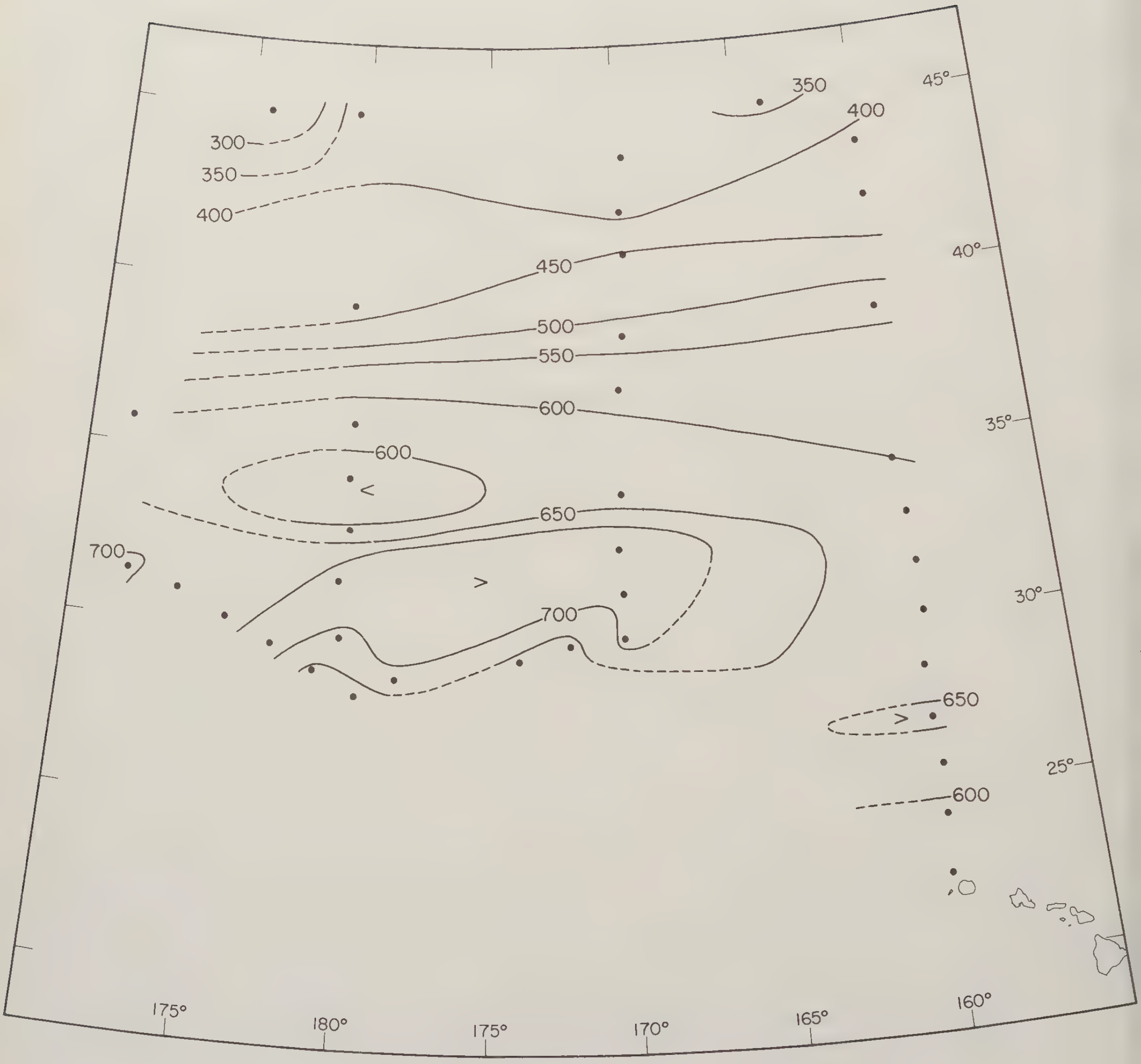
160°

Figure 26.--Depth of the 26.0 sigma-t surface in meters; Charles H. Gilbert cruise 17, September-November 1954. Contour interval 50 m. Dots indicate station positions.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180°
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165°
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Figure 27.--Depth of the 26.8 sigma-t surface in meters; Charles H. Gilbert cruise 17, September-November 1954. Contour interval 50 m. Dots indicate station positions.

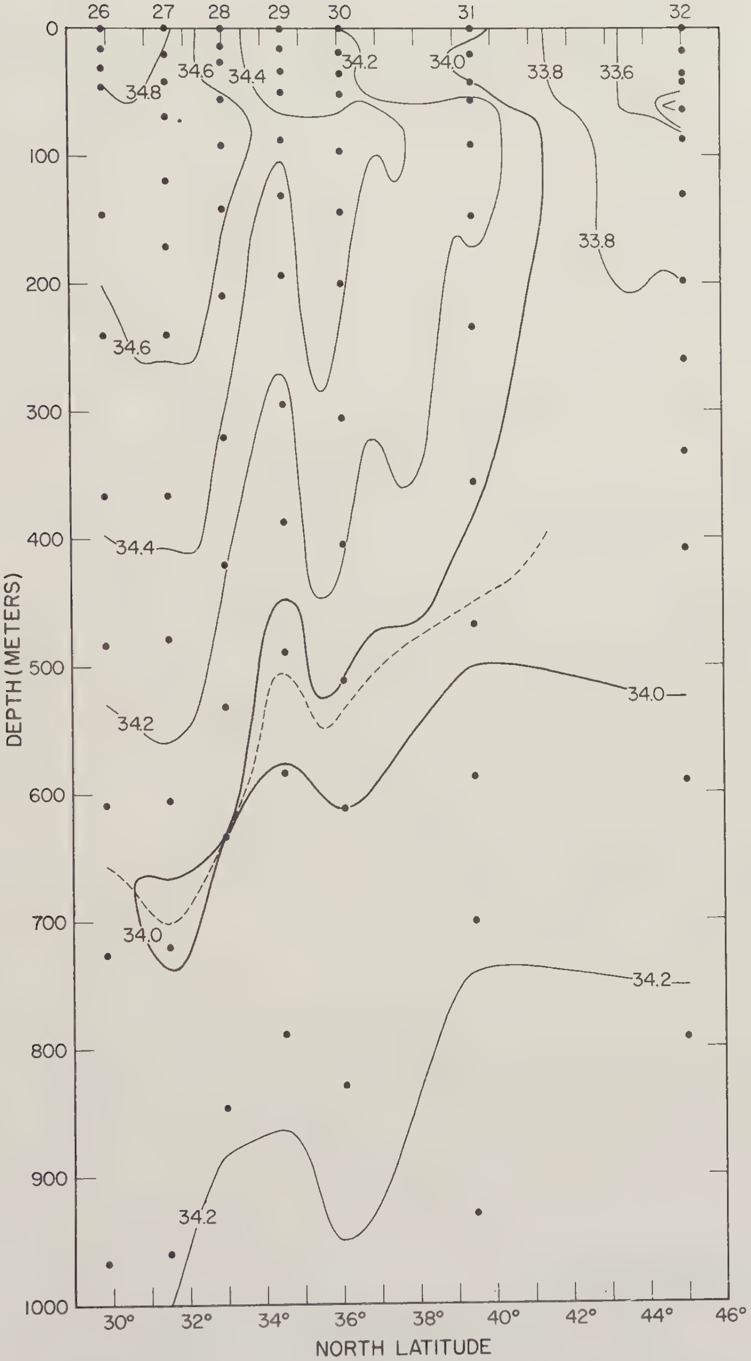


Figure 28.--Vertical section of salinity in parts per thousand along the 180th meridian; Charles H. Gilbert cruise 17, stations 26-32, September-November 1954. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.

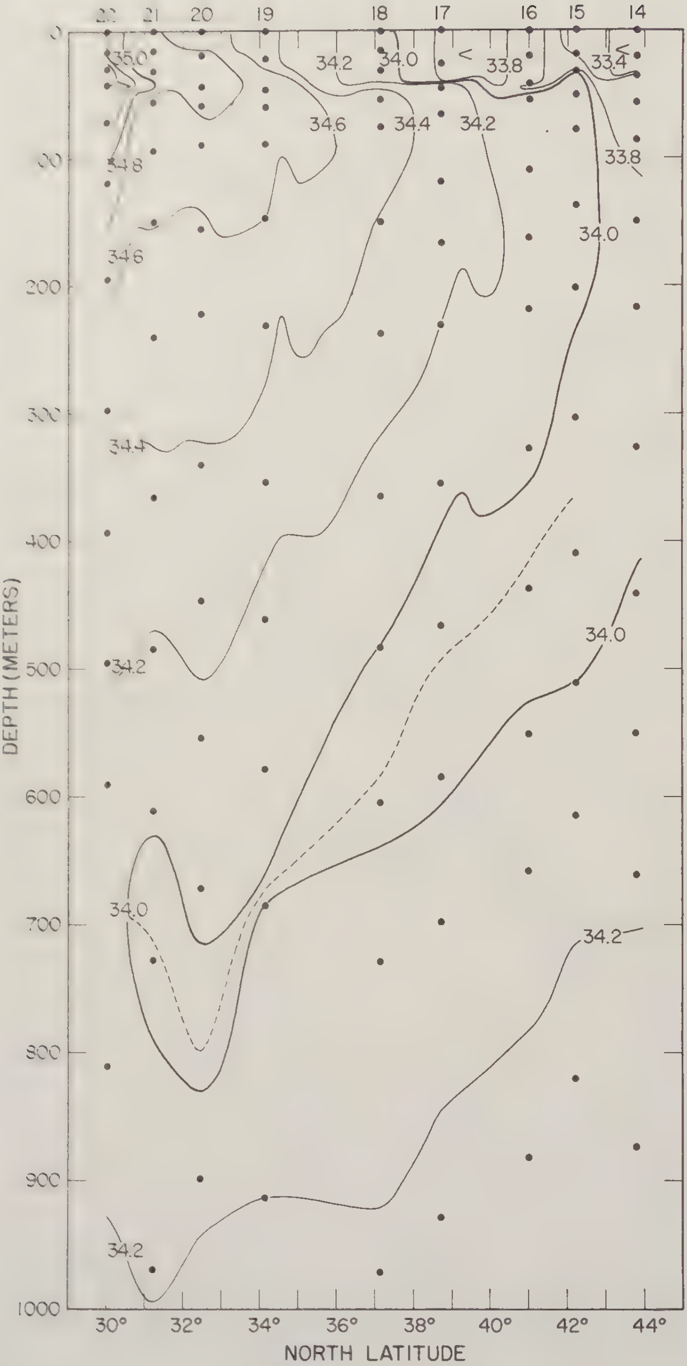


Figure 29.--Vertical section of salinity in parts per thousand along 170° W. longitude; Charles H. Gilbert cruise 17, stations 14-22, September-November 1954. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.

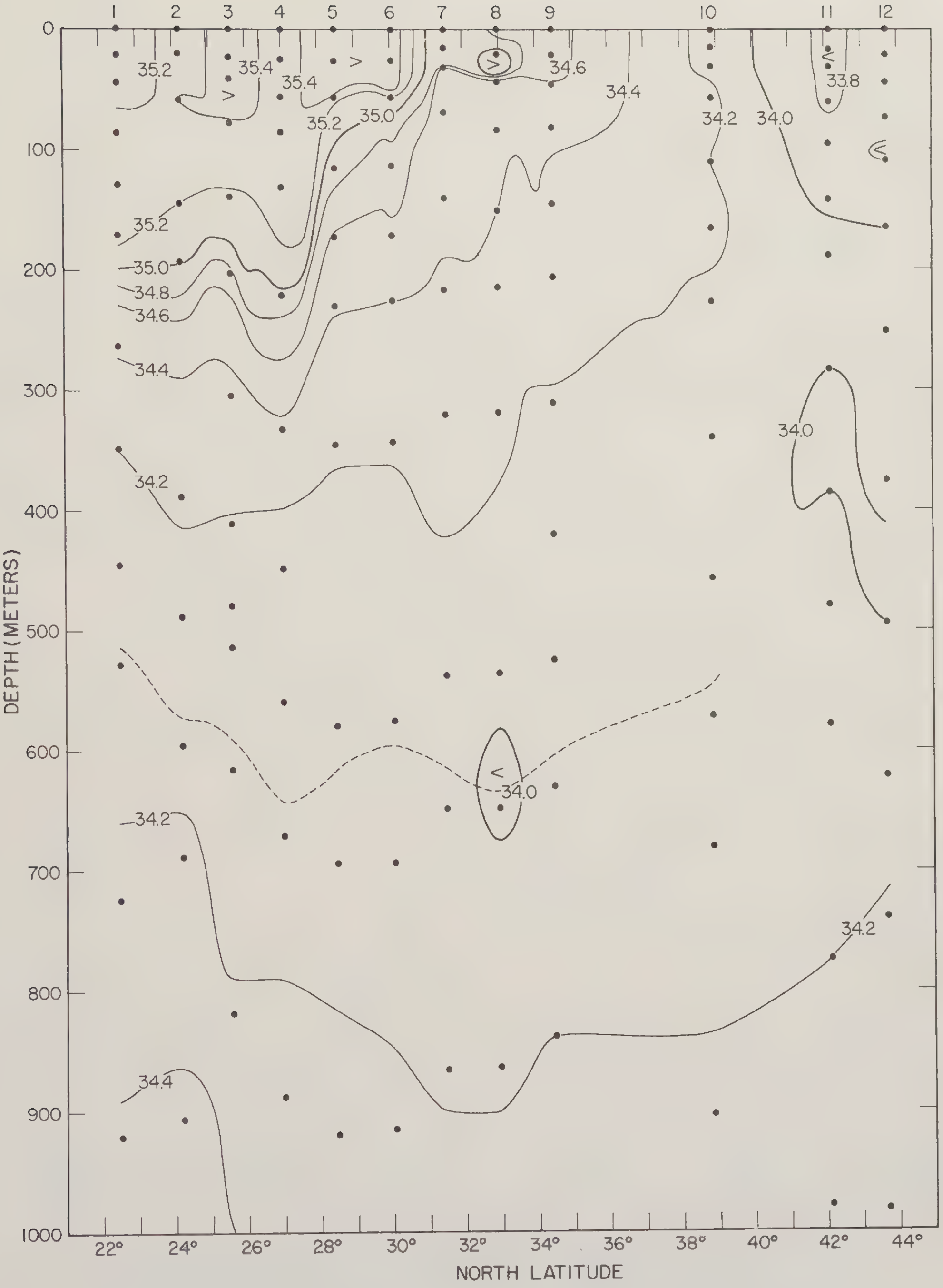
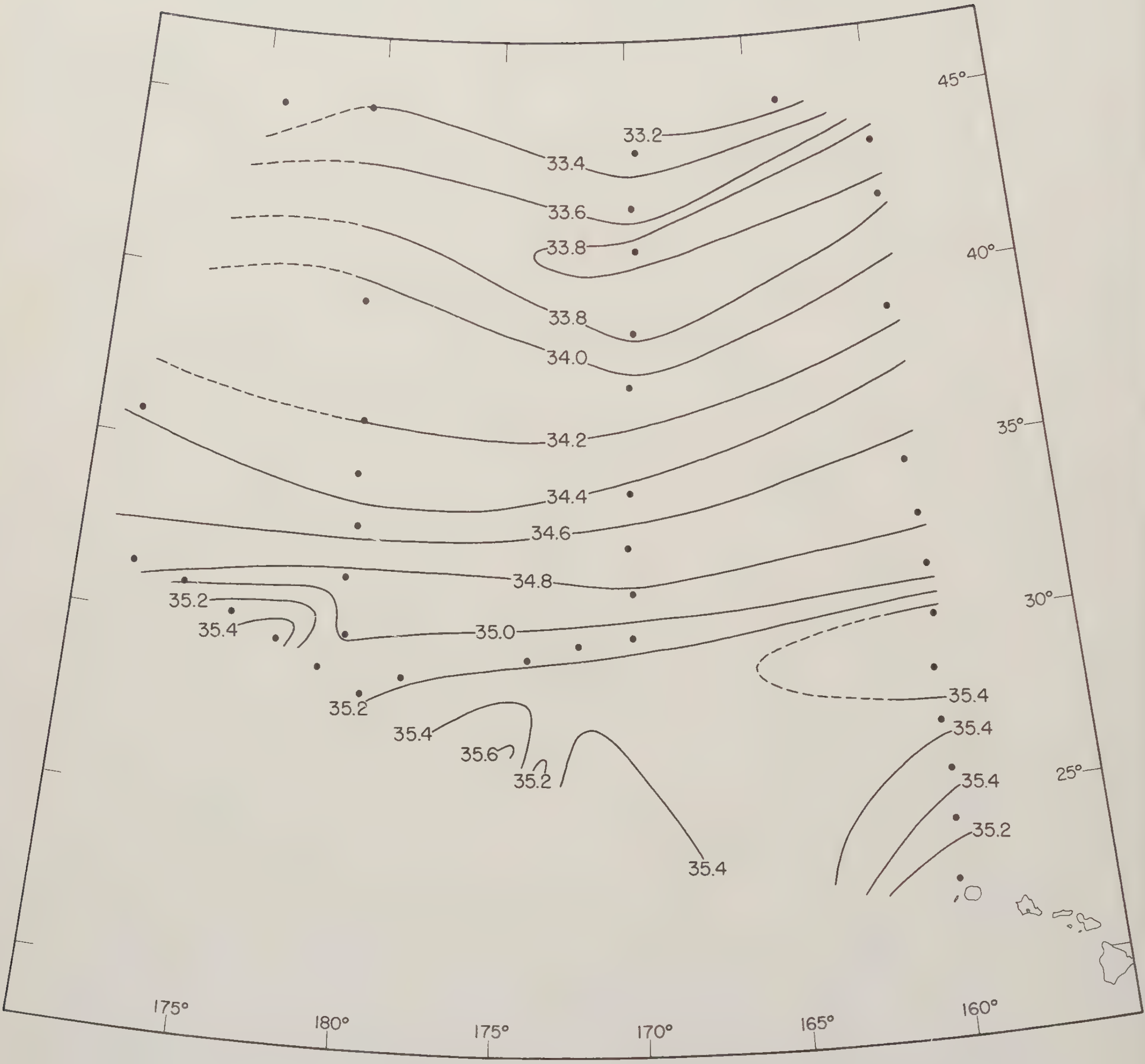
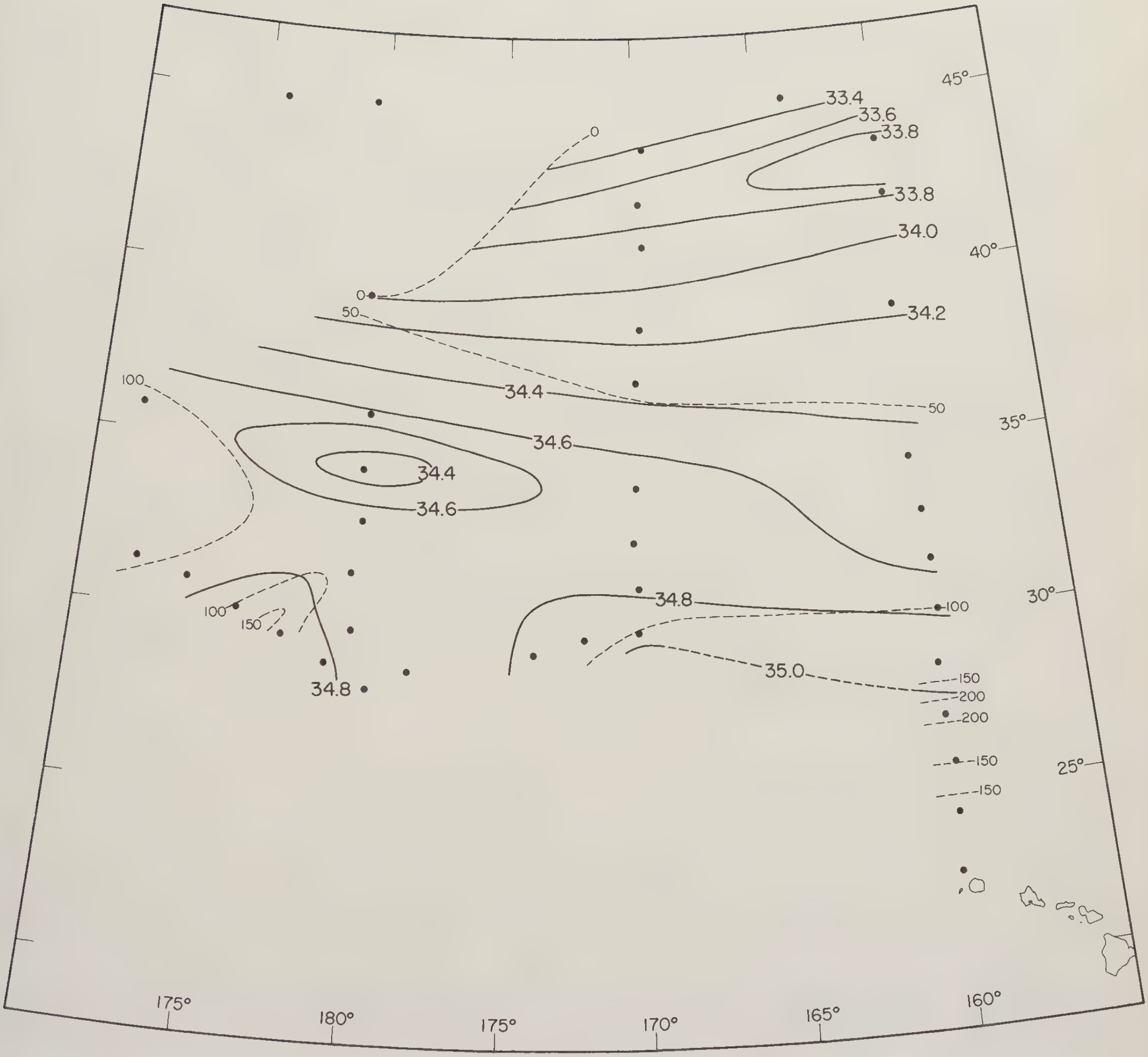


Figure 30.--Vertical section of salinity in parts per thousand along 160°W. longitude; Charles H. Gilbert cruise 17, stations 1-12, September-November 1954. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.



45°
40°
35°
30°
25°
33.2
33.4
33.6
33.8
33.8
34.0
34.2
34.4
34.6
34.8
35.0
35.2
35.4
35.2
35.4
35.6
35.2
35.4
35.4
35.4
35.4
35.2
35.4
175°
180°
175°
170°
165°
160°

Figure 31.--Surface salinity in parts per thousand; Charles H. Gilbert cruise 17, September-November 1954. Contour interval 0.2 ‰. Dots indicate observed values.



45°
40°
35°
30°
25°
175°
180°
175°
170°
165°
160°
33.4
33.6
33.8
33.8
34.0
34.2
34.4
34.6
34.4
34.6
34.8
34.8
35.0
0
0
50
50
100
100
150
100
150
200
200
150
150

Figure 32.--Salinity in parts per thousand (solid lines) on the 25.2 sigma-t surface (depth in meters, dotted lines); Charles H. Gilbert cruise 17, September-November 1954. Contour intervals: salinity 0.2 ‰, depth of sigma-t surface 50 m. Dots indicate station positions.

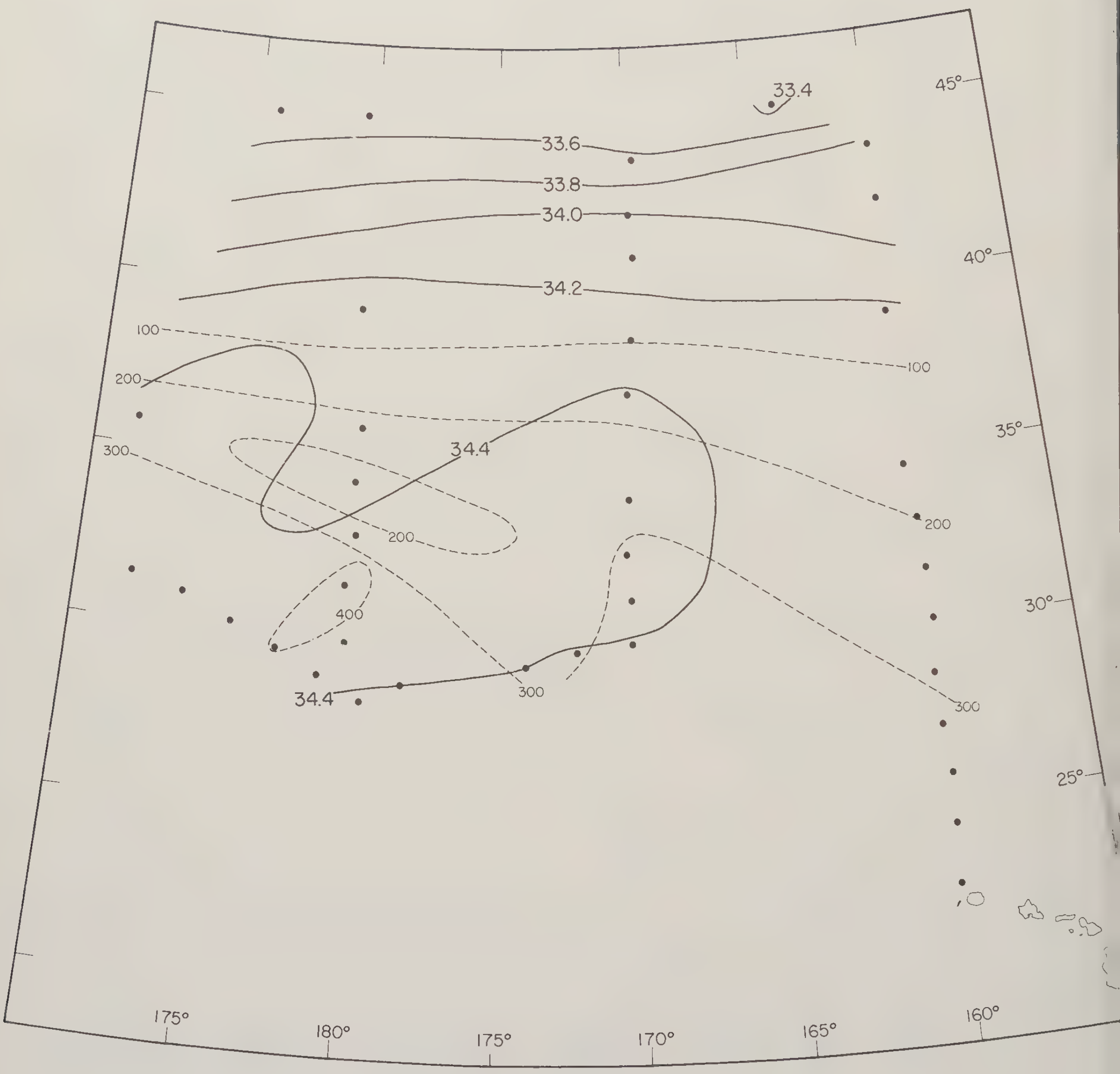

33.4
33.6
33.8
34.0
34.2
34.4
34.4
100
100
200
200
200
200
300
300
300
400
45°
40°
35°
30°
25°
175°
180°
175°
170°
165°
160°

Figure 33.--Salinity in parts per thousand (solid lines) on the 26.0 sigma-t surface (depth in meters, dotted lines); Charles H. Gilbert cruise 17, September-November 1954. Contour intervals: salinity 0.2 ‰, depth of sigma-t surface 100 m. Dots indicate station positions.

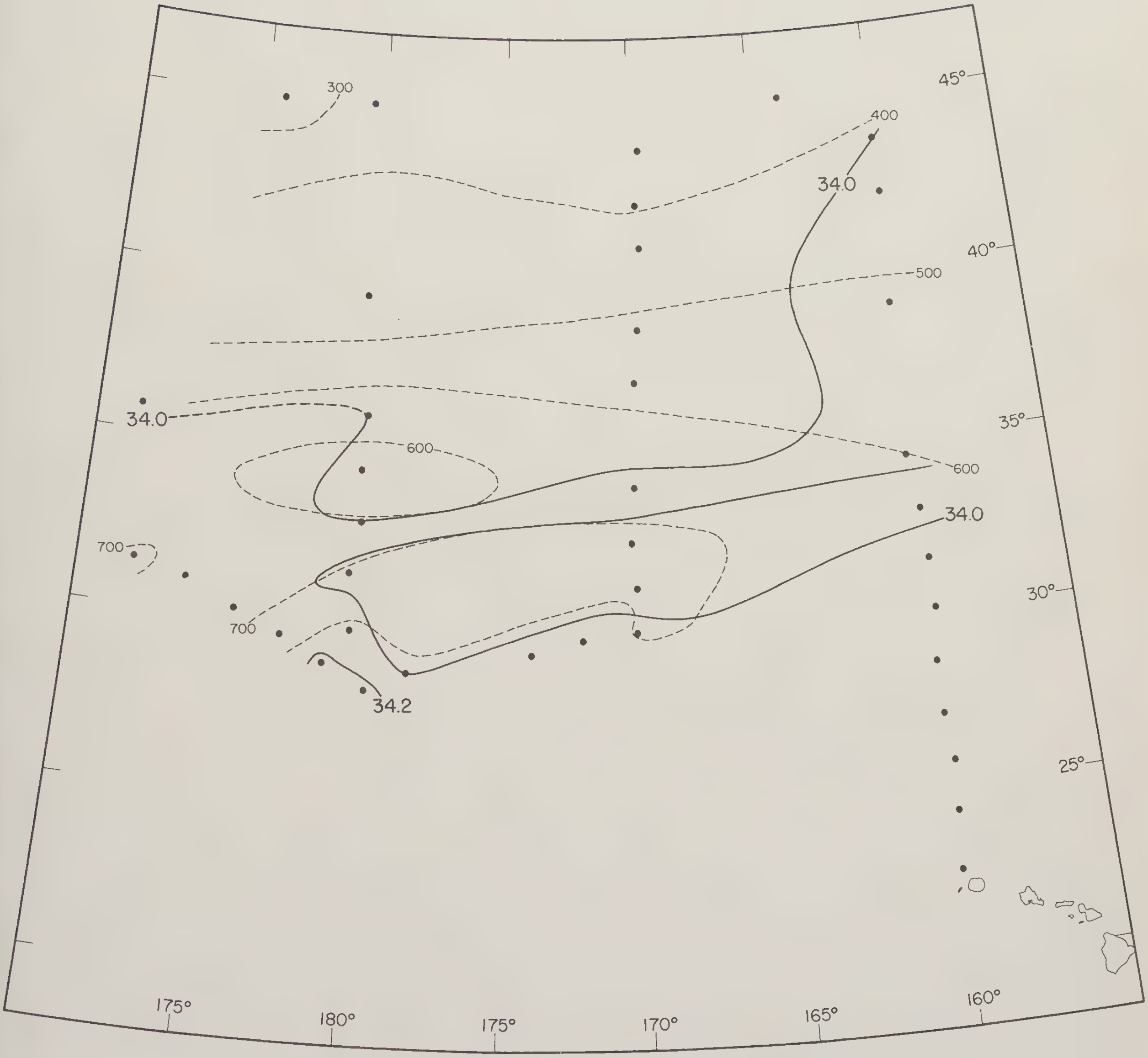

300
400
34.0
45°
40°
500
35°
34.0
600
600
34.0
700
30°
700
34.2
25°
175°
180°
175°
170°
165°
160°

Figure 34.--Salinity in parts per thousand (solid lines) on the 26.8 sigma-t surface (depth in meters, dotted lines); Charles H. Gilbert cruise 17, September-November 1954. Contour intervals: salinity 0.2 ‰, depth of sigma-t surface 100 m. Dots indicate station positions.

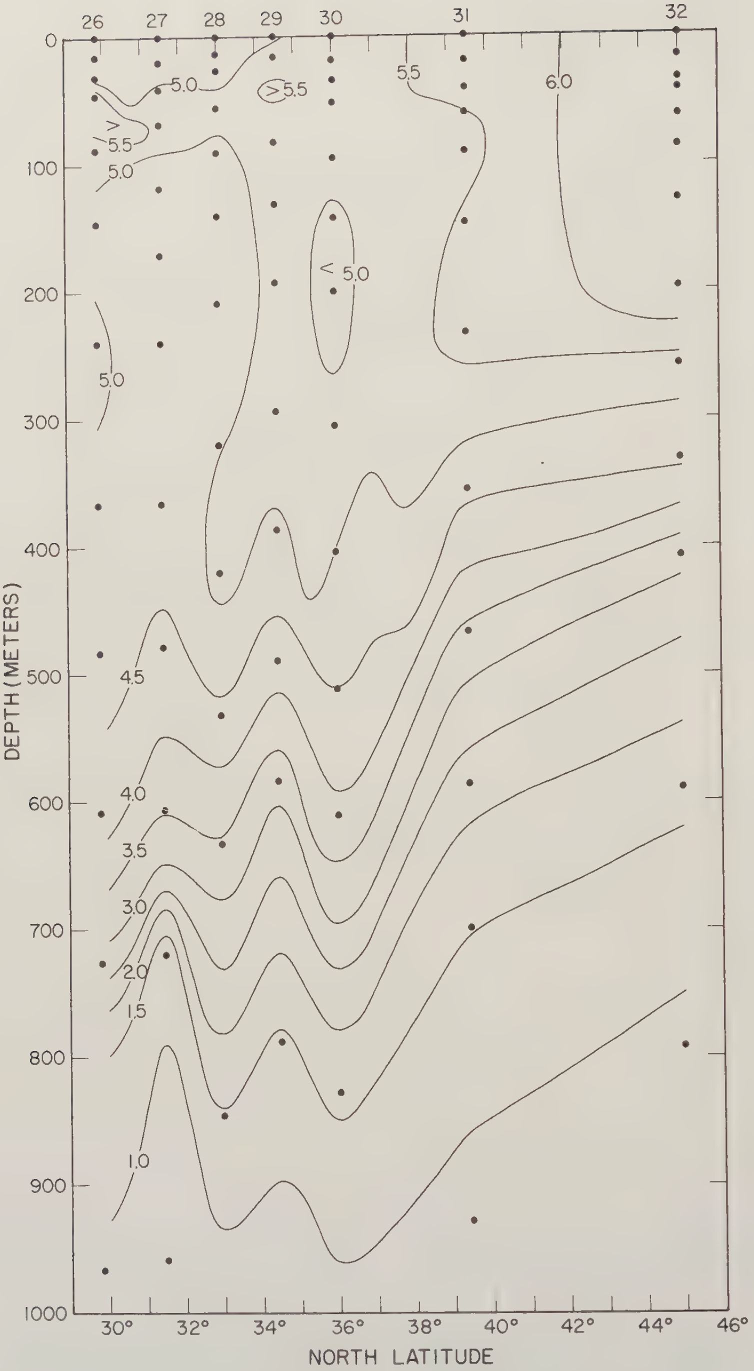


Figure 35.--Vertical section of dissolved oxygen in milliliters per liter along the 180th meridian; Charles H. Gilbert cruise 17, stations 26-32, September- November 1954. Contour interval: 0.5 ml./l. Points indicate observed values.

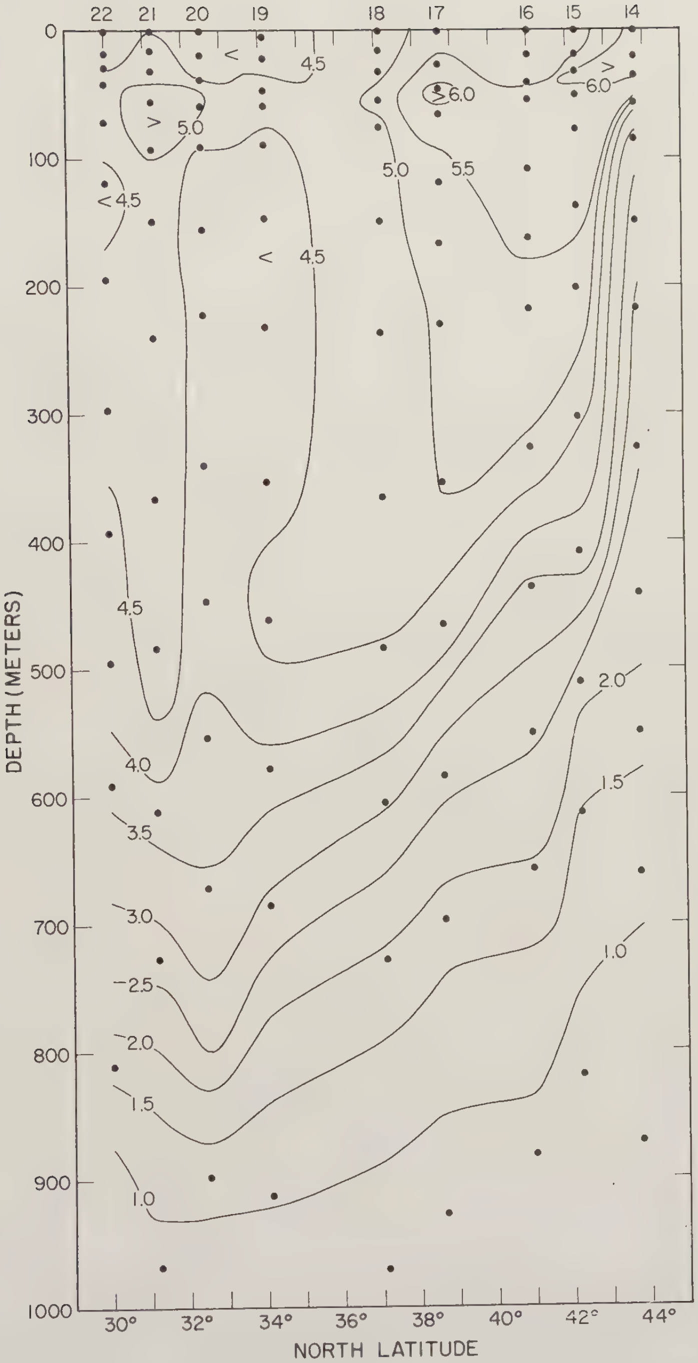


Figure 36.--Vertical section of dissolved oxygen in milliliters per liter along 170° W. longitude; Charles H. Gilbert cruise 17, stations 14-22, September-November 1954. Contour interval: 0.5 ml./l. Points indicate observed values.

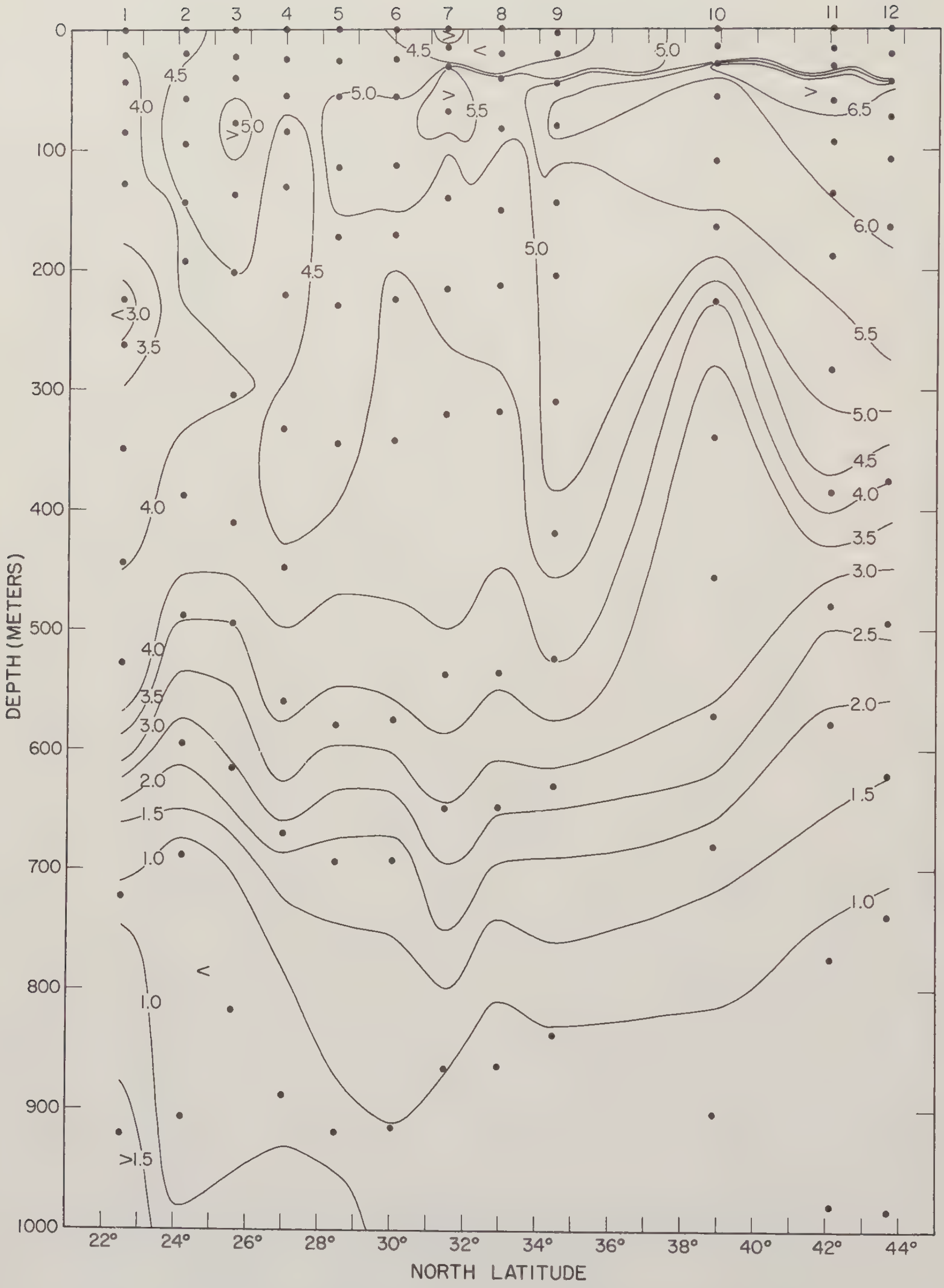


Figure 37.--Vertical section of dissolved oxygen in milliliters per liter along 160°W. longitude; Charles H. Gilbert cruise 17, stations 1-12, September-November 1954. Contour interval: 0.5 ml./l. Points indicate observed values.

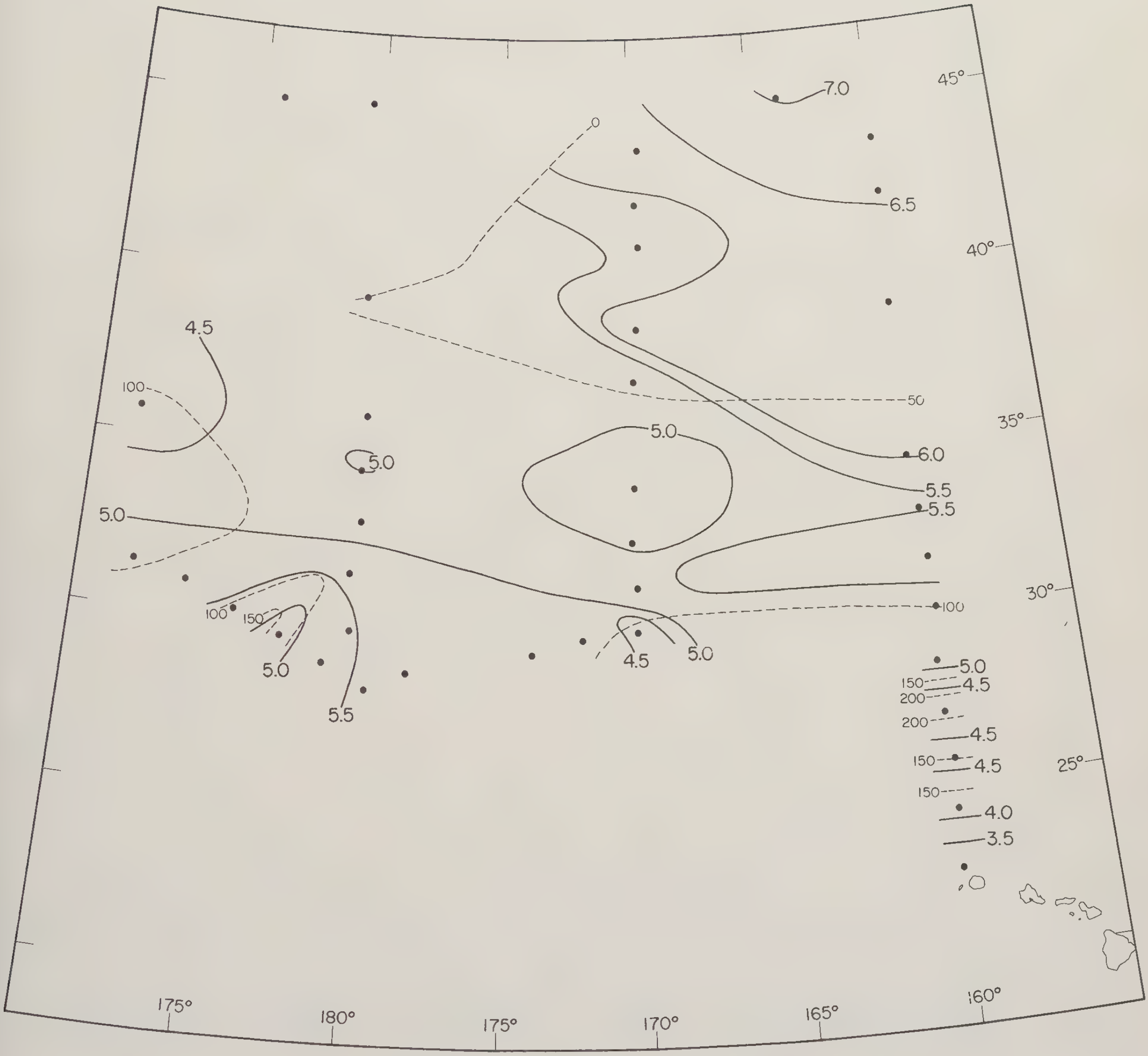

7.0
6.5
6.0
5.5
5.5
5.0
5.0
5.0
4.5
4.5
5.0
5.5
4.5
5.0
4.5
4.5
4.0
3.5
0
50
100
100
100
150
150
200
200
150
150
45°
40°
35°
30°
25°
175°
180°
175°
170°
165°
160°

Figure 38.--Dissolved oxygen in milliliters per liter (solid lines) on the 25.2 sigma-t surface (depths in meters, dotted lines); Charles H. Gilbert cruise 17, September-November 1954. Contour intervals: dissolved oxygen 0.5 ml./l., depth of sigma-t surface 50 m. Dots indicate station positions.

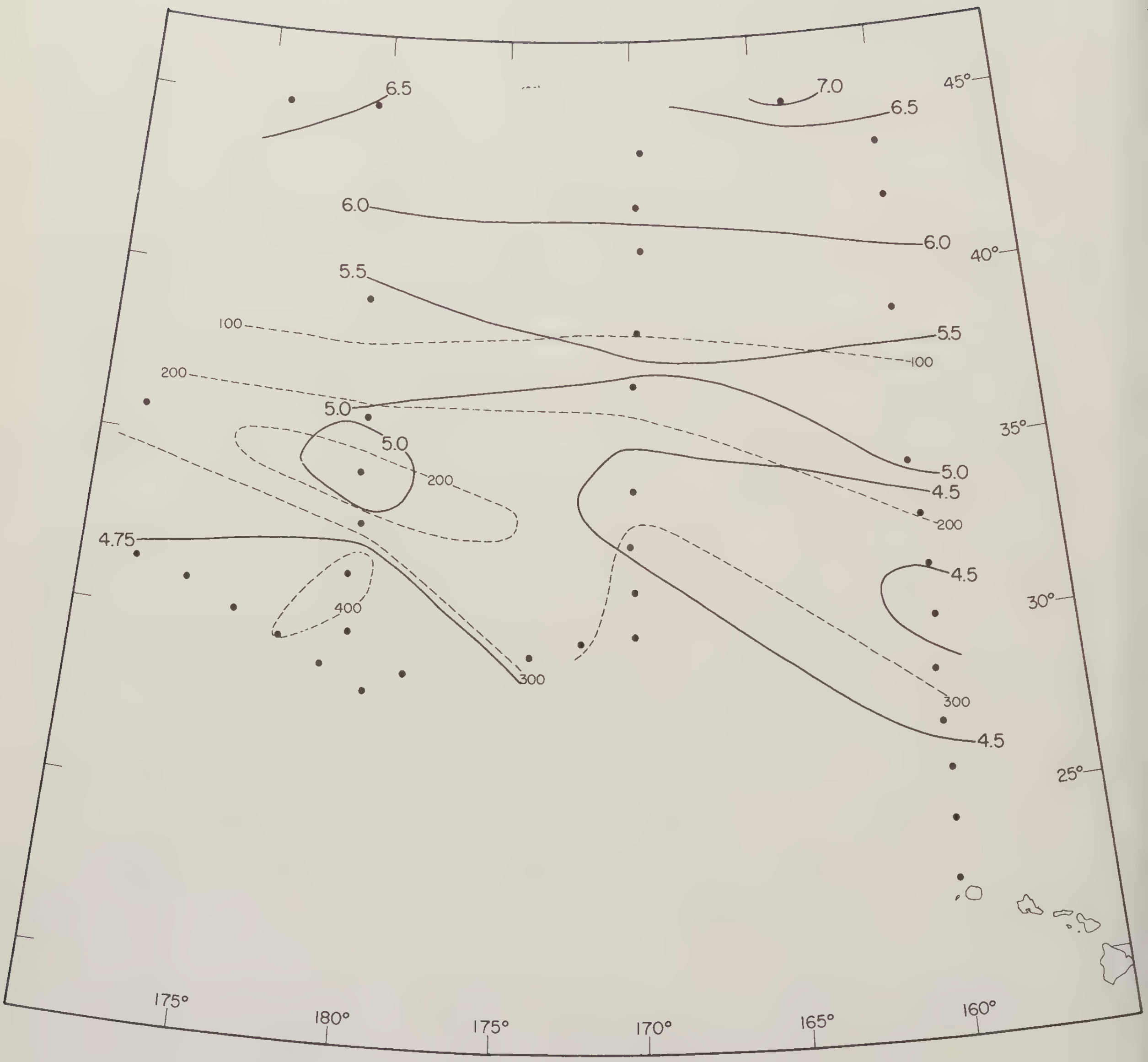

6.5
7.0
6.5
45°
6.0
6.0
40°
5.5
100
5.5
100
200
5.0
5.0
200
35°
5.0
4.5
200
4.75
4.5
30°
400
300
300
4.5
25°
175°
180°
175°
170°
165°
160°

Figure 39.--Dissolved oxygen in milliliters per liter (solid lines) on the 26.0 sigma-t surface (depth in meters, dotted lines); Charles H. Gilbert cruise 17, September-November 1954. Contour intervals: dissolved oxygen 0.5 ml./l., depth of sigma-t surface 100 m. Dots indicate station positions.

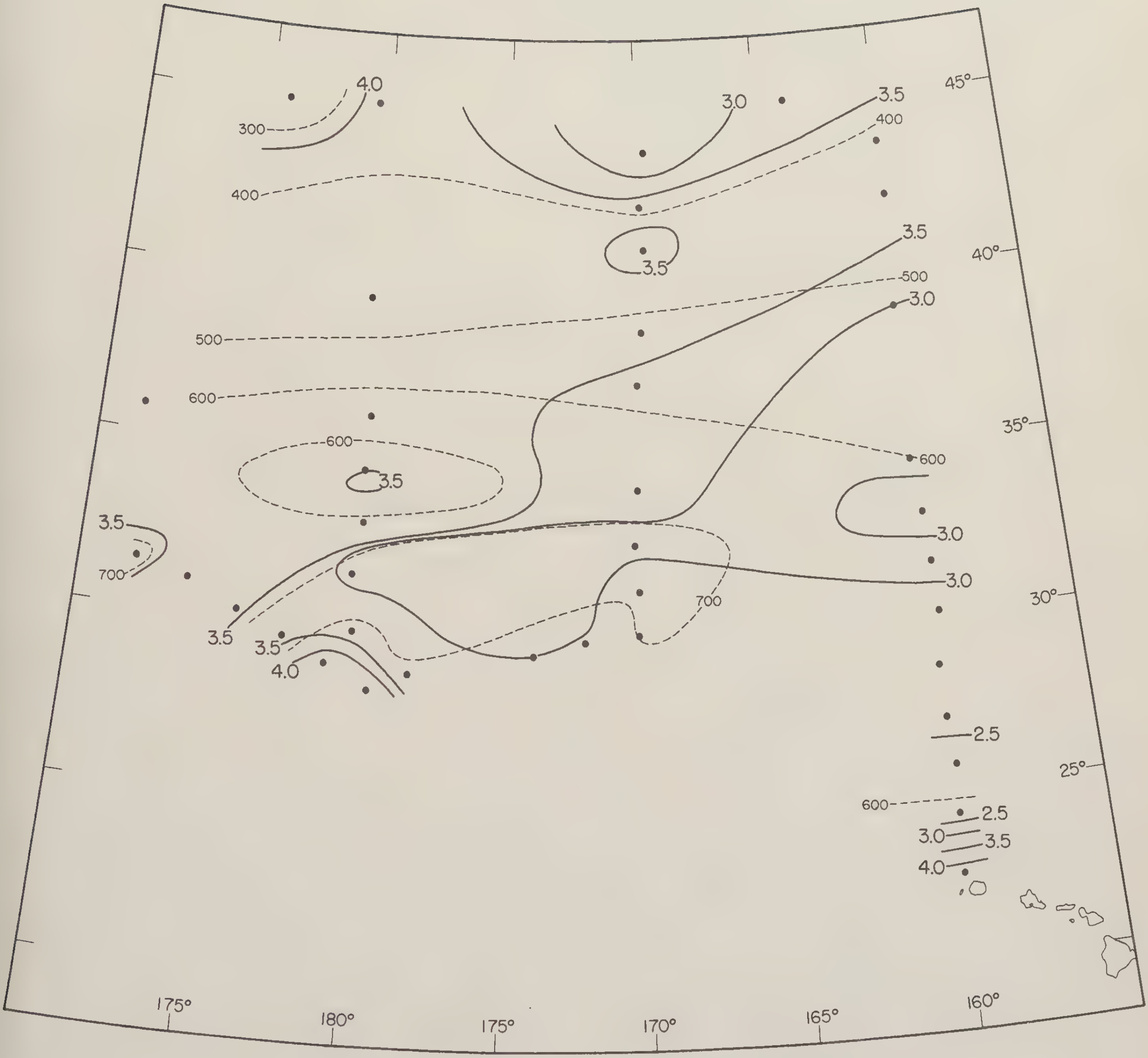

4.0
300
3.0
3.5
400
45°
400
3.5
3.5
40°
500
3.0
500
600
35°
600
600
3.5
3.5
3.0
700
3.0
30°
700
3.5
3.5
4.0
2.5
25°
600
2.5
3.0
3.5
4.0
175°
180°
175°
170°
165°
160°

Figure 40.--Dissolved oxygen in milliliters per liter (solid lines) on the 26.8 sigma-t surface (depth in meters, dotted lines); Charles H. Gilbert cruise 17, September-November 1954. Contour intervals: dissolved oxygen 0.5 ml. /l., depth of sigma-t surface 100 m. Dots indicate station positions.

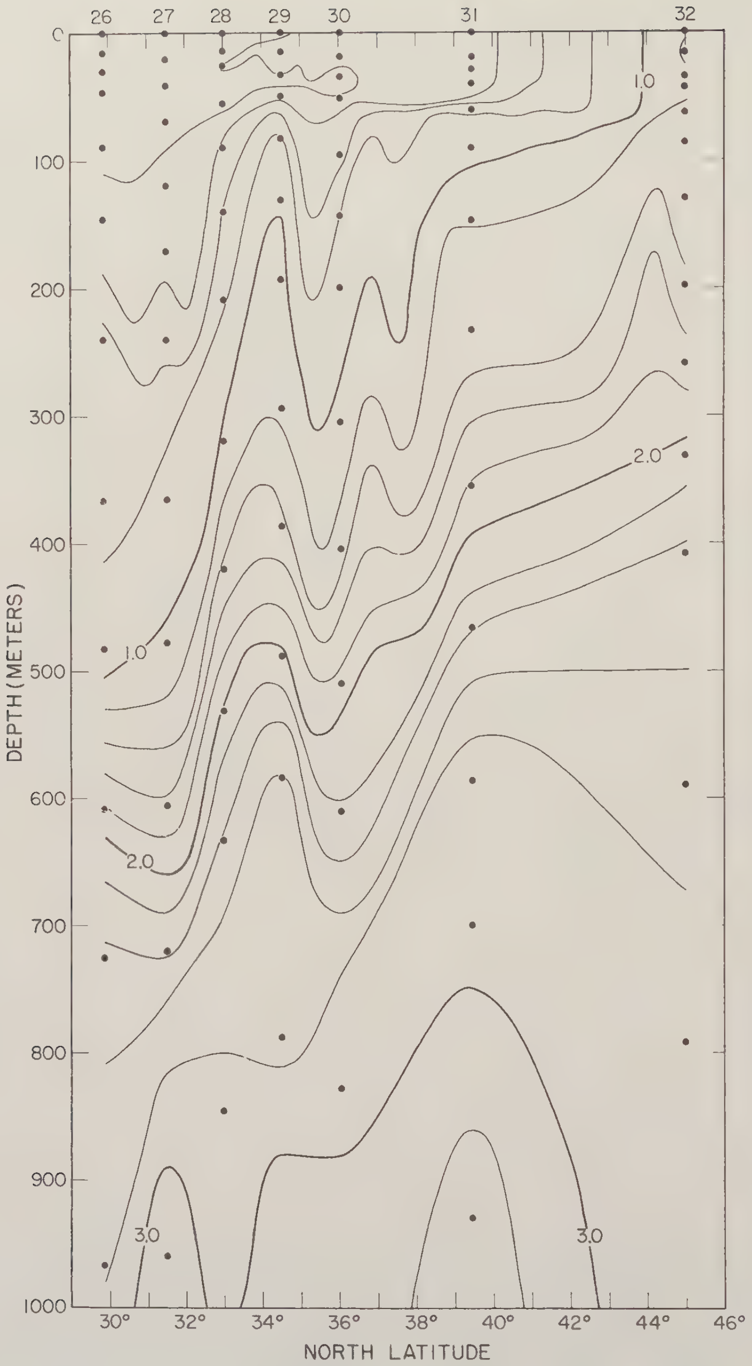


Figure 41. --Vertical section of inorganic phosphate in microgram-atoms per liter along the 180th meridian; Charles H. Gilbert cruise 17, stations 26-32, September-November 1954. Contour interval 0.2 µg at./l.

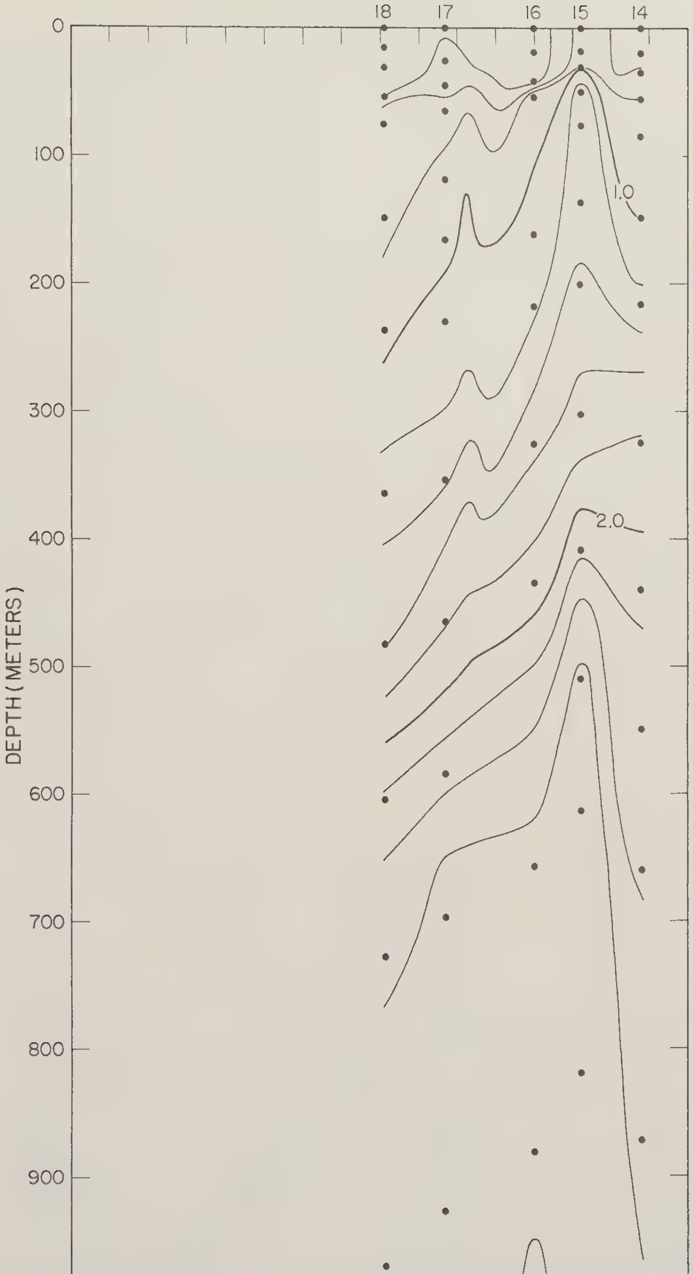


Figure 42.--Vertical section of inorganic phosphate in microgram-atoms per liter along 170°W. longitude; Charles H. Gilbert cruise 17, stations 14-18, September-November 1954. Contour interval 0.2 µg at./l.

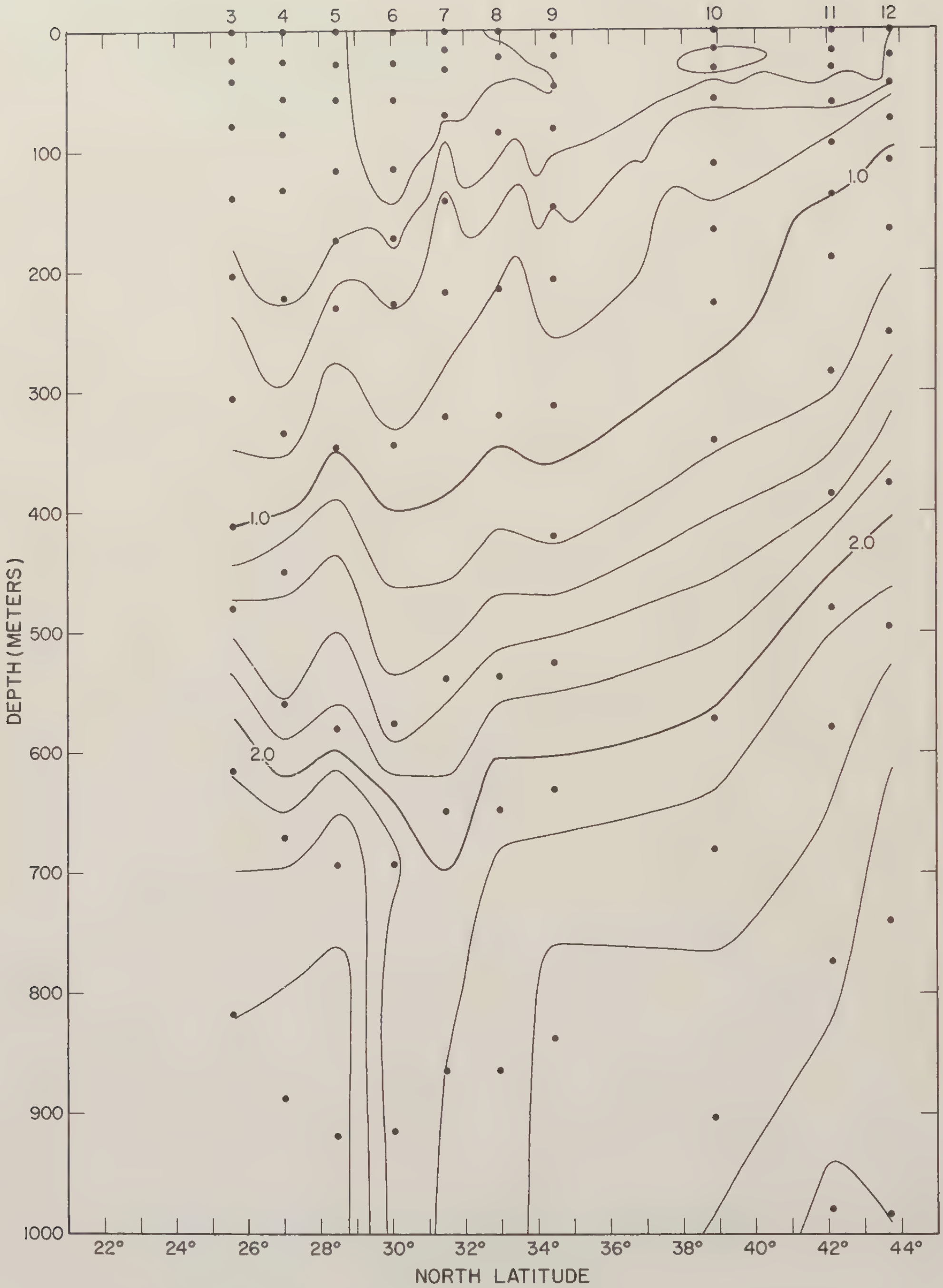


Figure 43.--Vertical section of inorganic phosphate in microgram-atoms per liter along 160°W. longitude; Charles H. Gilbert cruise 17, stations 3-12, September-November 1954. Contour interval 0.2 μg at./l.

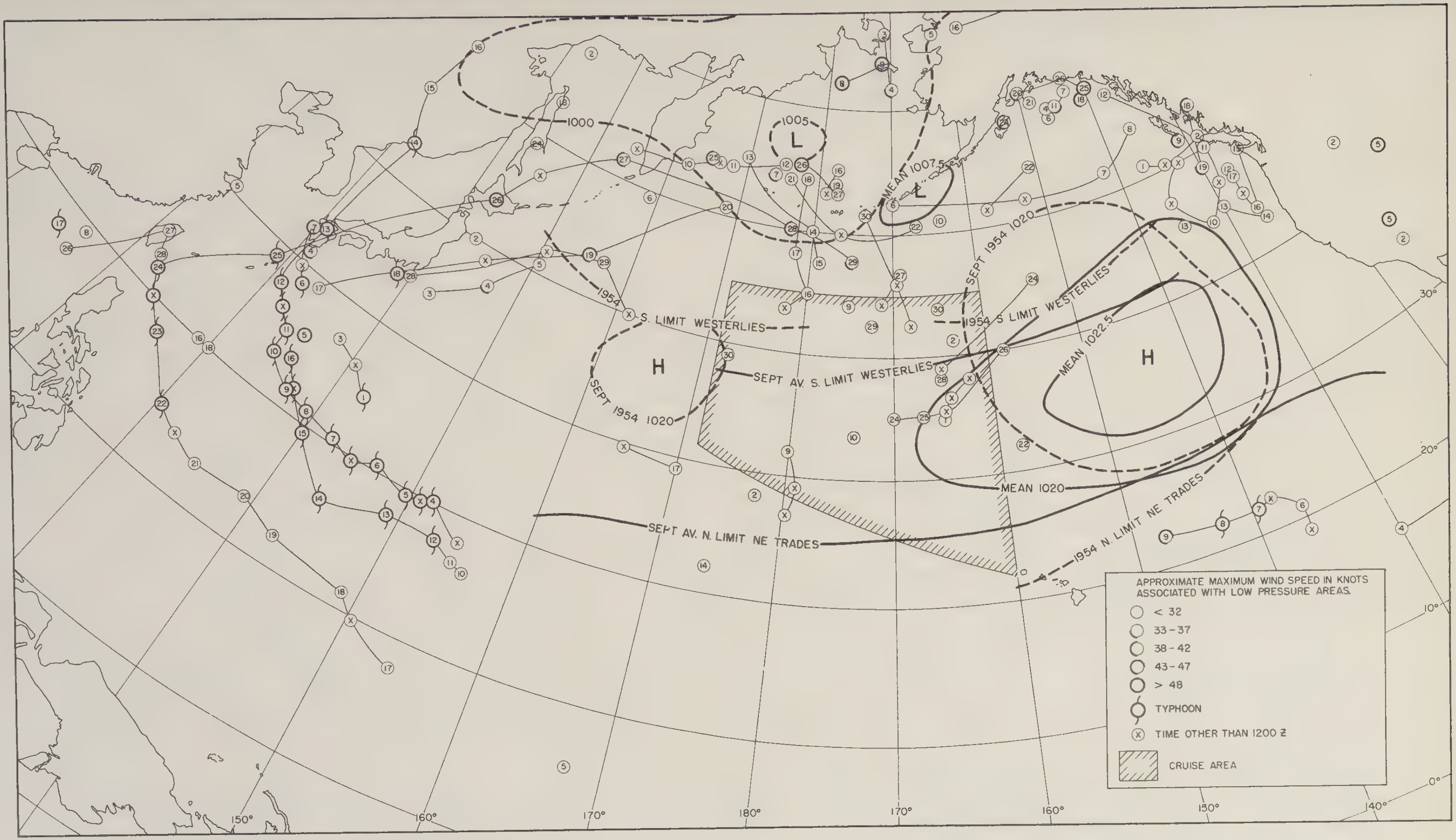

1000
1005
L
MEAN 1007.5
L
SEPT 1954 1020
1954 S LIMIT WESTERLIES
MEAN 1022.5
H
1954 S. LIMIT WESTERLIES
H
SEPT 1954 1020
SEPT AV. S. LIMIT WESTERLIES
MEAN 1020
SEPT AV. N. LIMIT NE TRADES
1954 N. LIMIT NE TRADES
APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS.
< 32
33 - 37
38 - 42
43 - 47
> 48
TYPHOON
TIME OTHER THAN 1200 Z
CRUISE AREA
30°
20°
10°
0°
150°
160°
170°
180°
170°
160°
150°
140°

Figure 44.--Normal (heavy solid lines) and mean September 1954 (broken lines) position of the Aleutian Low and Eastern North Pacific High; normal and 1954 mean monthly limits of the northeast trades and westerlies; tracks of centers of low pressure areas, showing daily positions.

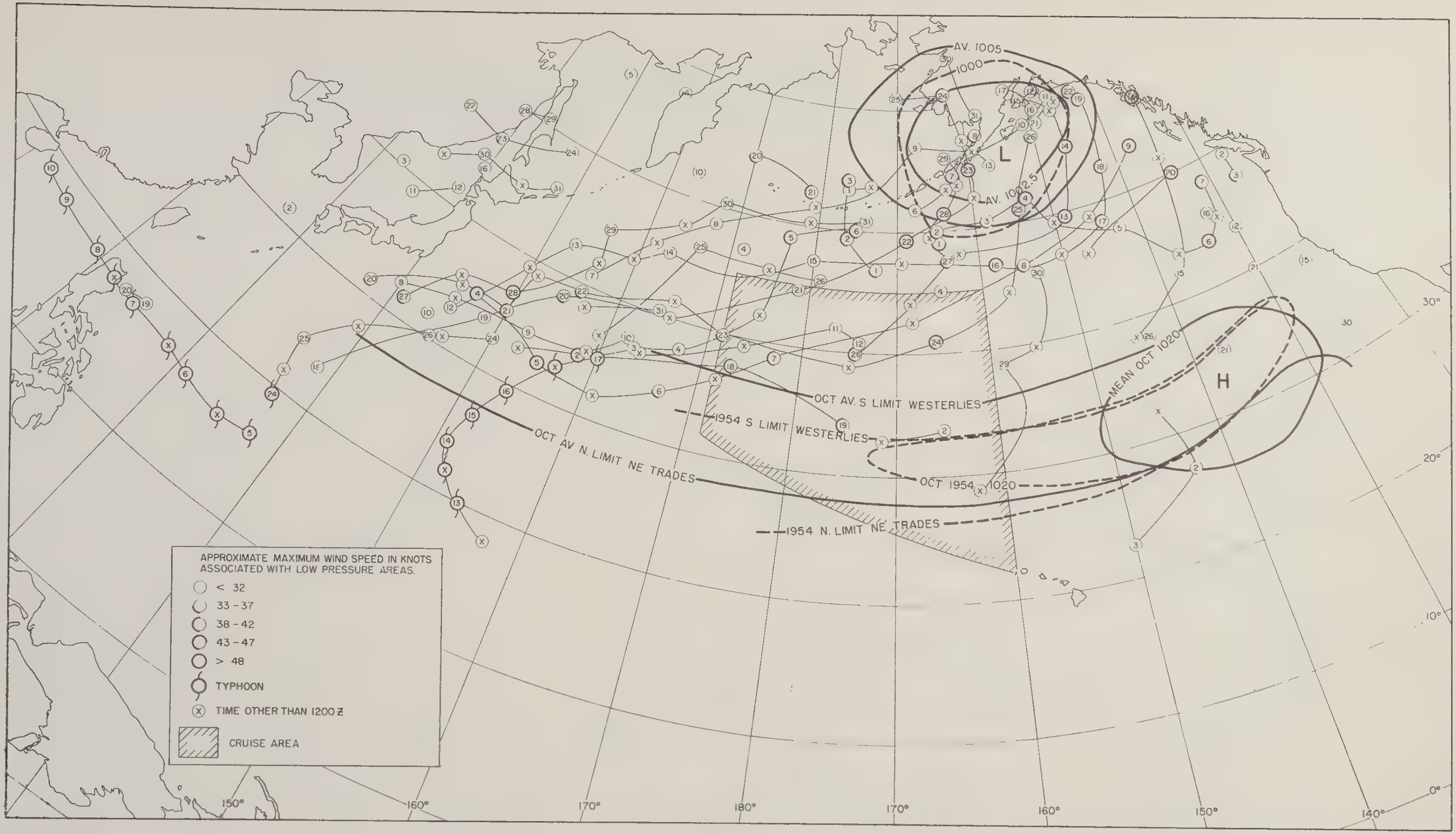

AV. 1005
1000
AV. 1002.5
L
H
MEAN OCT 1020
OCT AV. S LIMIT WESTERLIES
1954 S LIMIT WESTERLIES
OCT 1954 1020
OCT AV N. LIMIT NE TRADES
1954 N. LIMIT NE TRADES
APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS.
< 32
33 - 37
38 - 42
43 - 47
> 48
TYPHOON
TIME OTHER THAN 1200 Z
CRUISE AREA
150°
160°
170°
180°
170°
160°
150°
140°
0°
10°
20°
30°

Figure 45.--Normal (heavy solid lines) and mean October 1954 (broken lines) position of the Aleutian Low and Eastern North Pacific High; normal and 1954 mean monthly limits of the northeast trades and westerlies; tracks of centers of low pressure areas, showing daily positions.

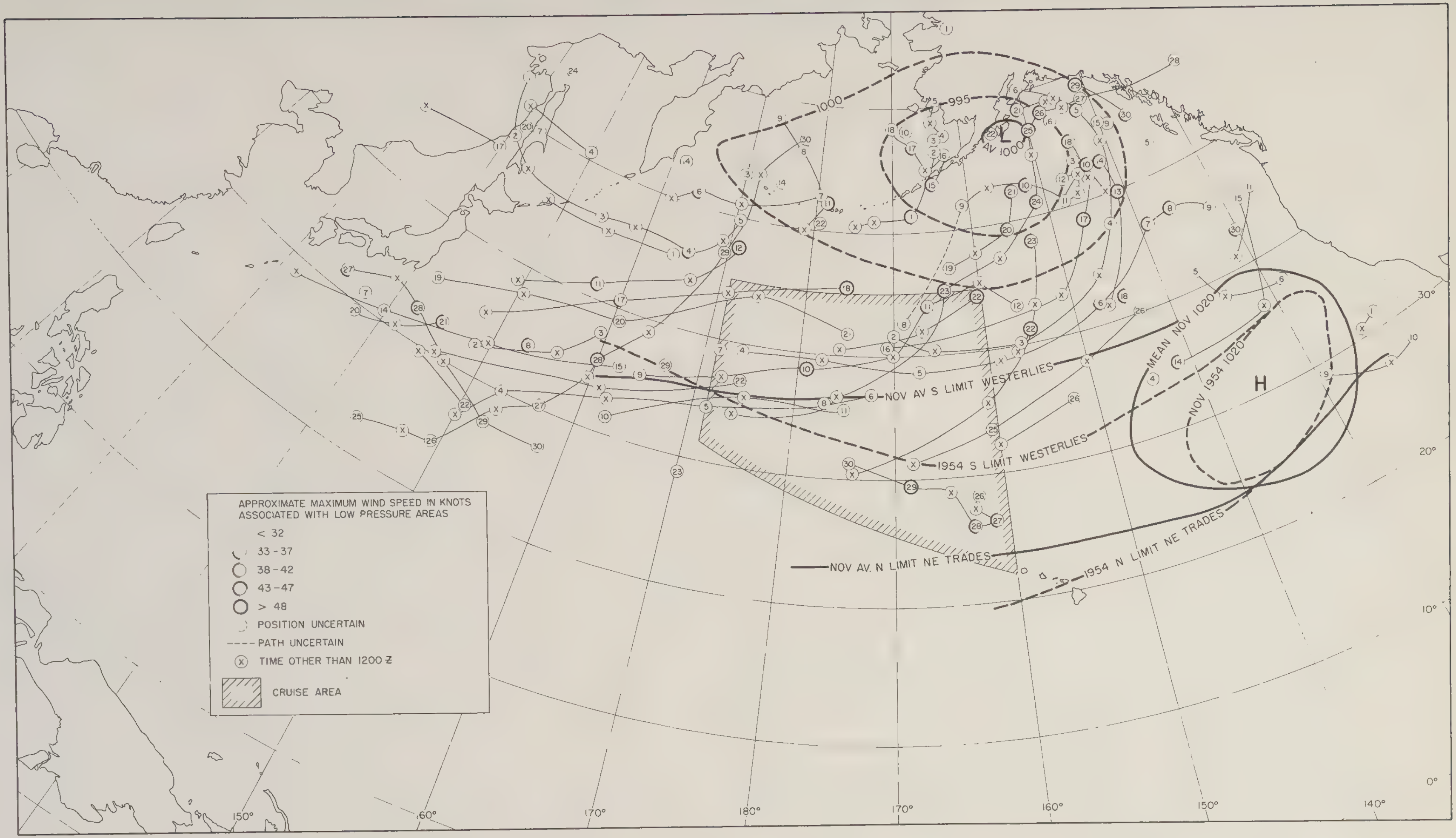

APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS
< 32
33 - 37
38 - 42
43 - 47
> 48
POSITION UNCERTAIN
PATH UNCERTAIN
TIME OTHER THAN 1200 Z
CRUISE AREA
L
AV 1000
995
1000
H
MEAN NOV 1020
NOV 1954 1020
NOV AV S LIMIT WESTERLIES
1954 S LIMIT WESTERLIES
NOV AV. N LIMIT NE TRADES
1954 N LIMIT NE TRADES
30°
20°
10°
0°
150°
160°
170°
180°
170°
160°
150°
140°

Figure 46.--Normal (heavy solid lines) and mean November 1954 (broken lines) position of the Aleutian Low and Eastern North Pacific High; normal and 1954 mean monthly limits of the northeast trades and westerlies; tracks of centers of low pressure areas, showing daily positions.

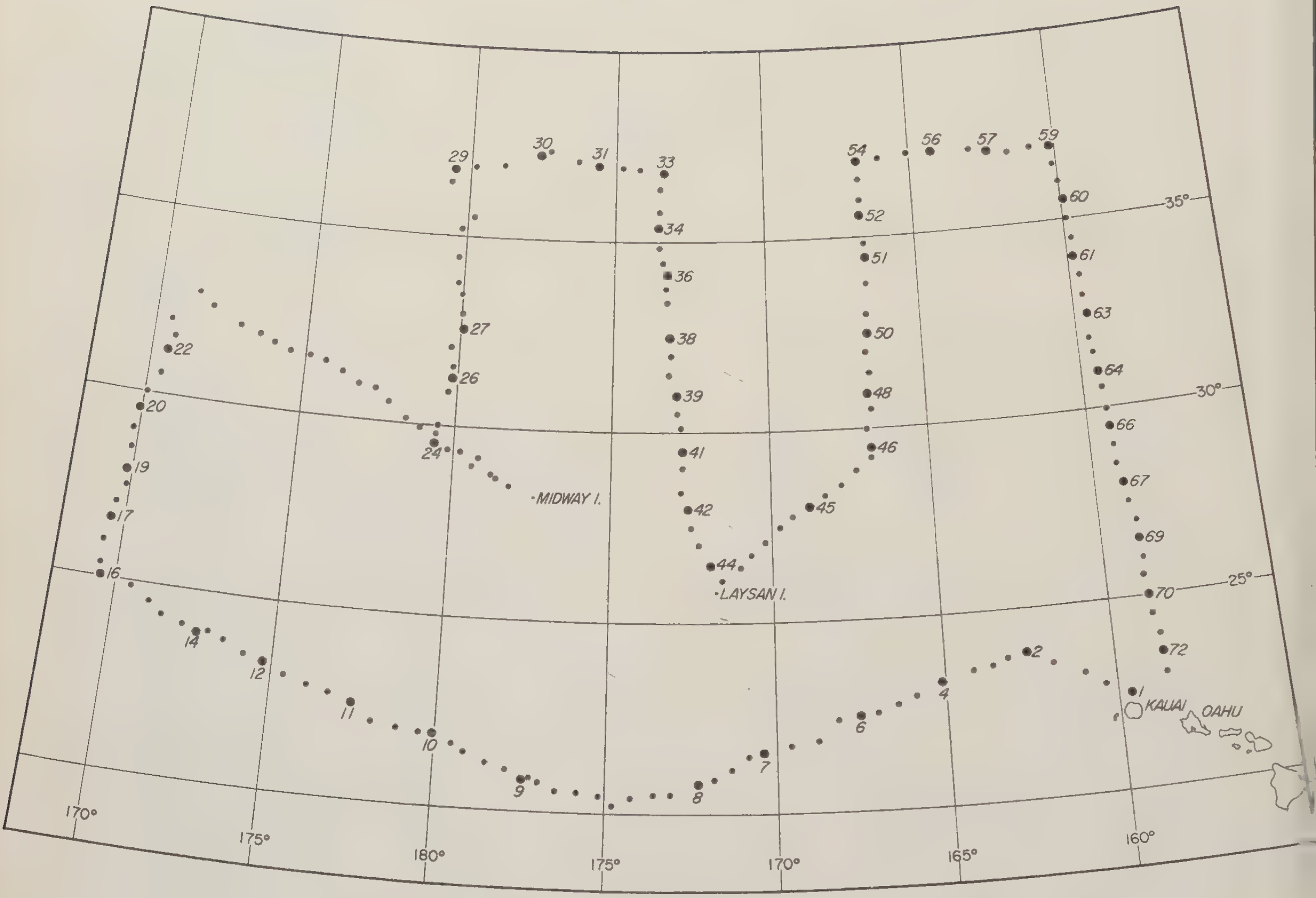
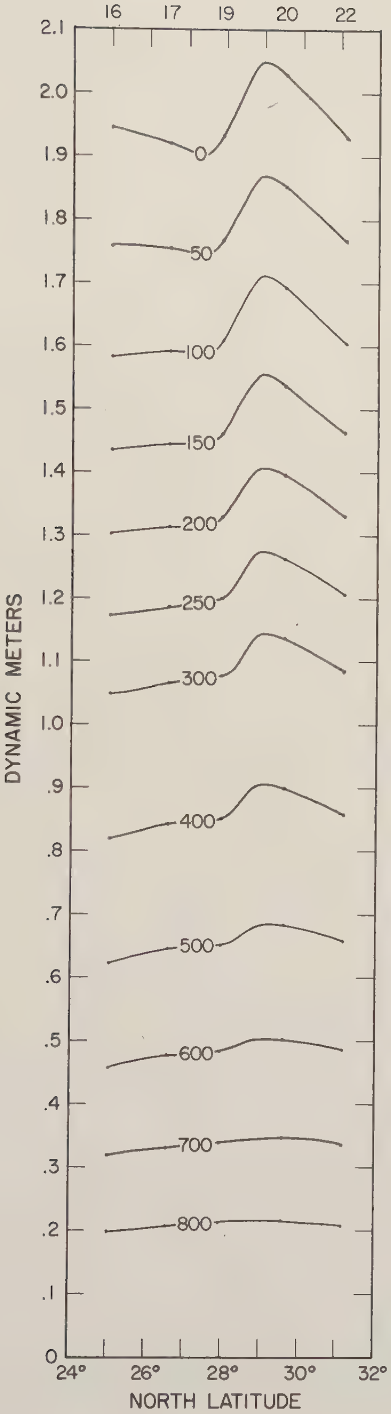

35°
30°
25°
170°
175°
180°
175°
170°
165°
160°
MIDWAY I.
LAYSAN I.
KAUAI
OAHU
1
2
4
6
7
8
9
10
11
12
14
16
17
19
20
22
24
26
27
29
30
31
33
34
36
38
39
41
42
44
45
46
48
50
51
52
54
56
57
59
60
61
63
64
66
67
69
70
72

Figure 47.--Oceanographic station positions, Hugh M. Smith cruise 27, January-February 1955. Large numbered dots indicate oceanographic stations. Small dots indicate positions of BT lowerings between stations.



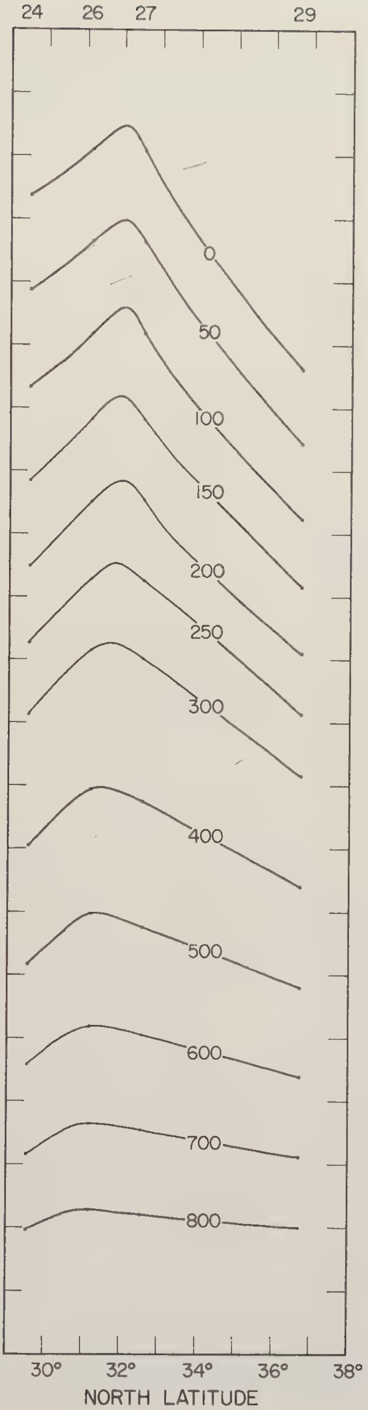
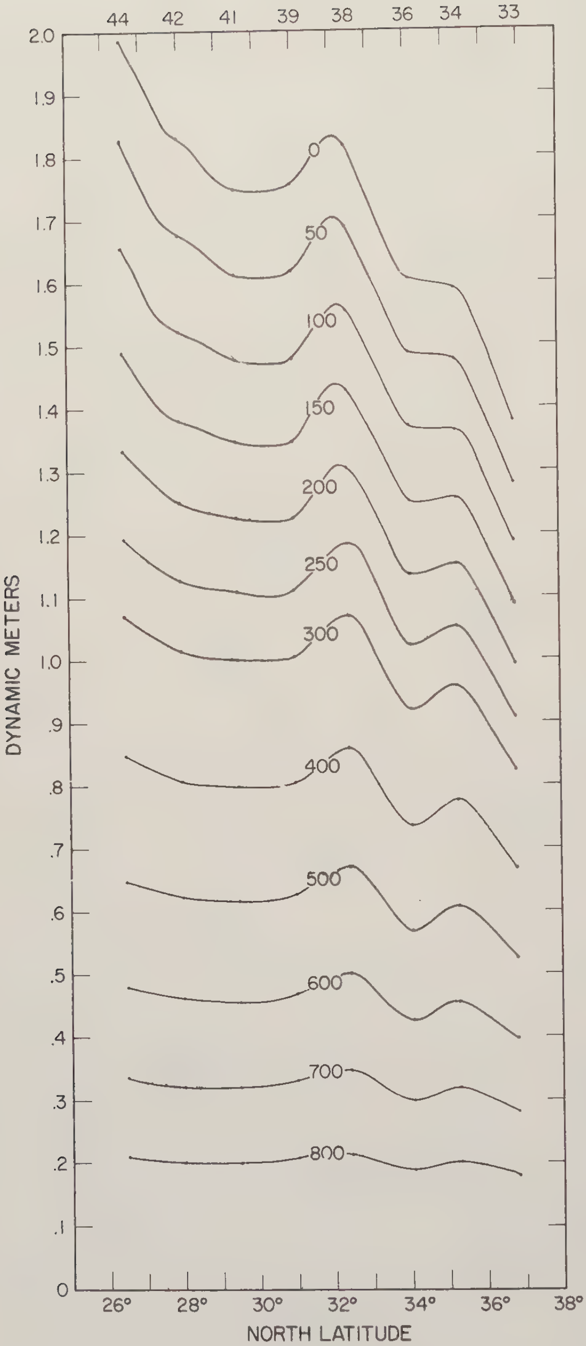


Figure 48.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface along 170°E. longitude; Hugh M. Smith cruise 27, stations 16-22, January-February 1955. Points represent computed values.

Figure 49.--Same along the 180th meridian, stations 24-29.



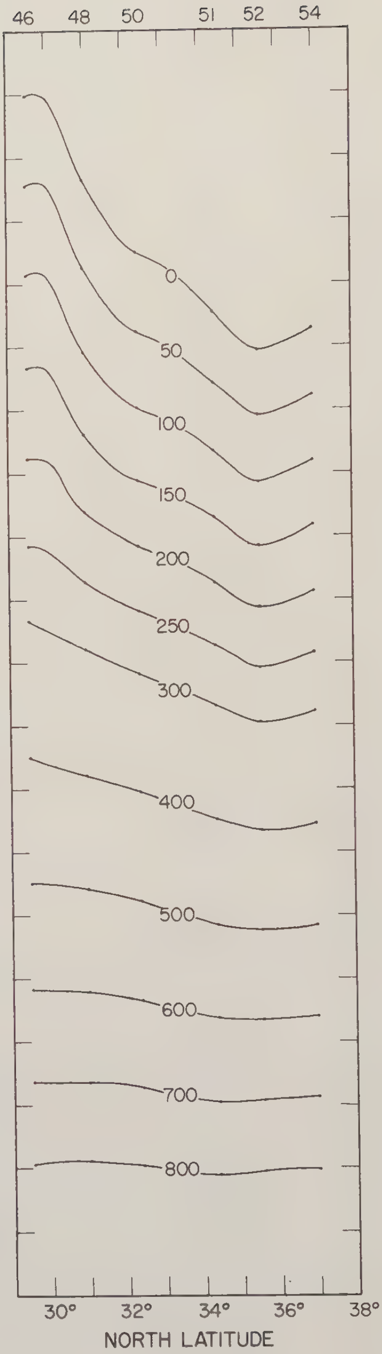


Figure 50.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface along 172°W. longitude; Hugh M. Smith cruise 27, stations 33-44, January-February 1955. Points represent computed values.

Figure 51.--Same along 167°W. longitude, stations 46-54.

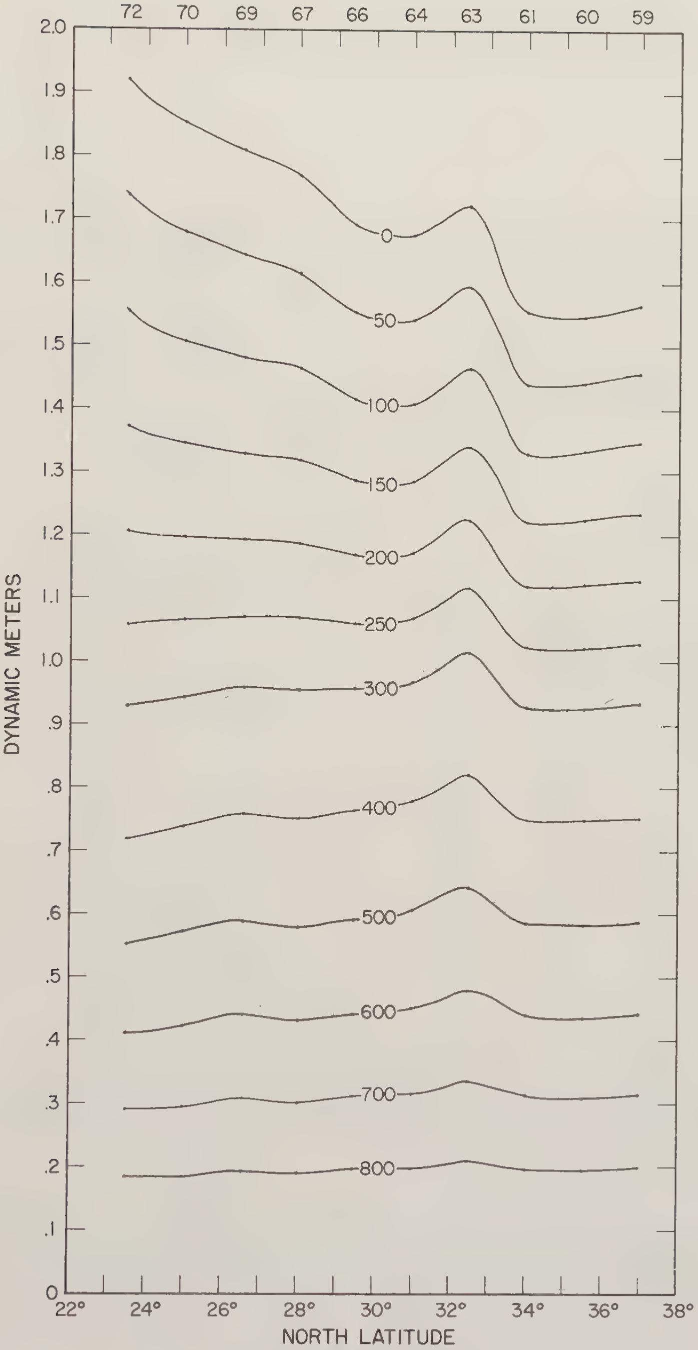
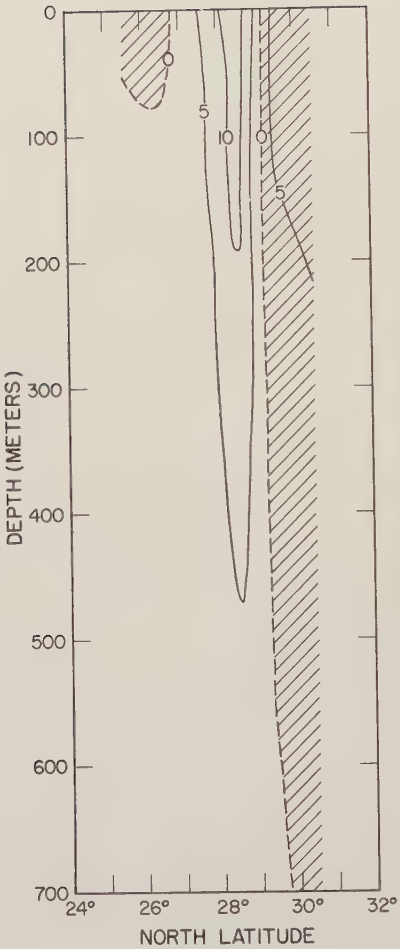


Figure 52.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface along 159°W. longitude; Hugh M. Smith cruise 27, stations 59-72, January-February 1955. Points represent computed values.



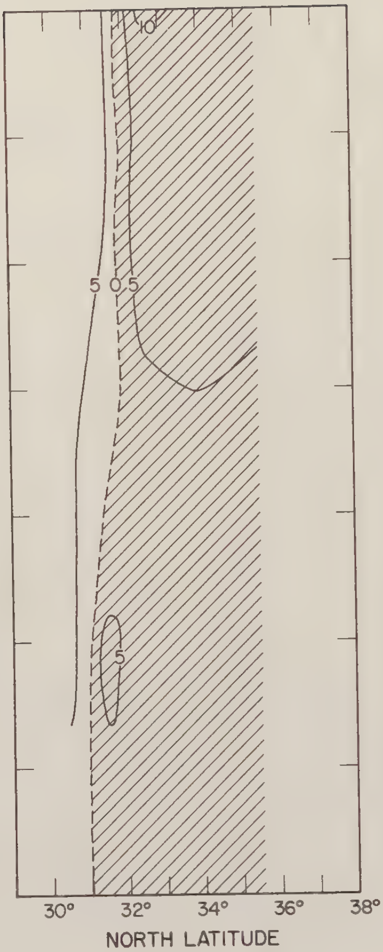
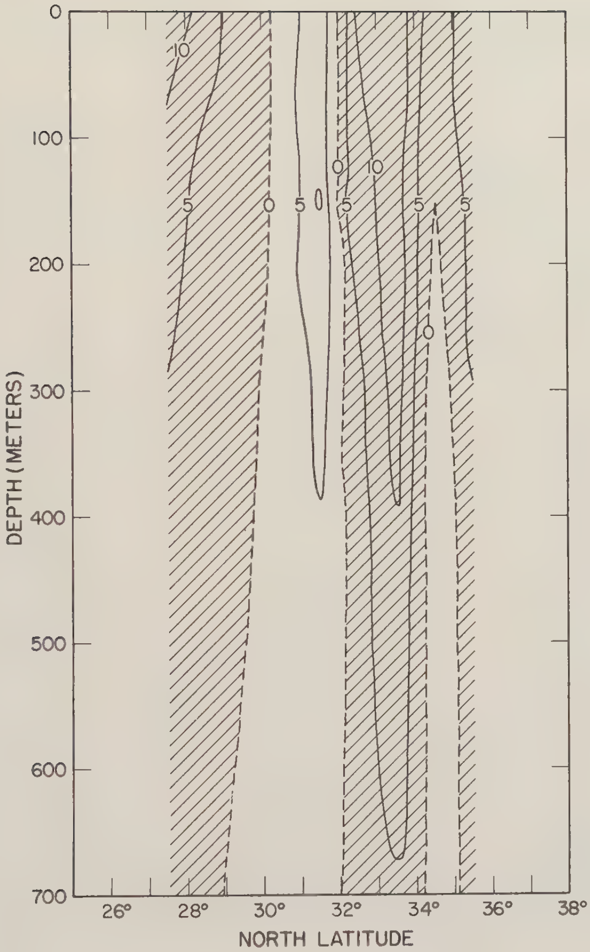


Figure 53.--Zonal components of the geostrophic currents in centimeters per second across 170°E. longitude; Hugh M. Smith cruise 27, January-February 1955. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

Figure 54.--Same across the 180th meridian.



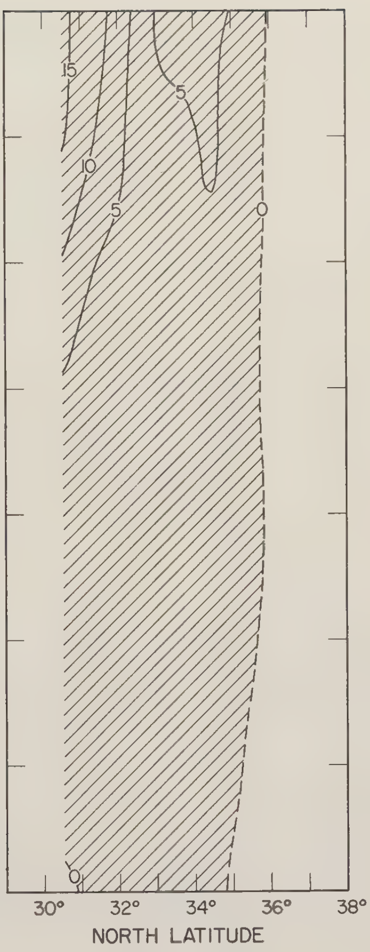


Figure 55. --Zonal components of the geostrophic currents in centimeters per second across 172°W. longitude; Hugh M. Smith cruise 27, January-February 1955. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

Figure 56. --Same across 167°W. longitude.

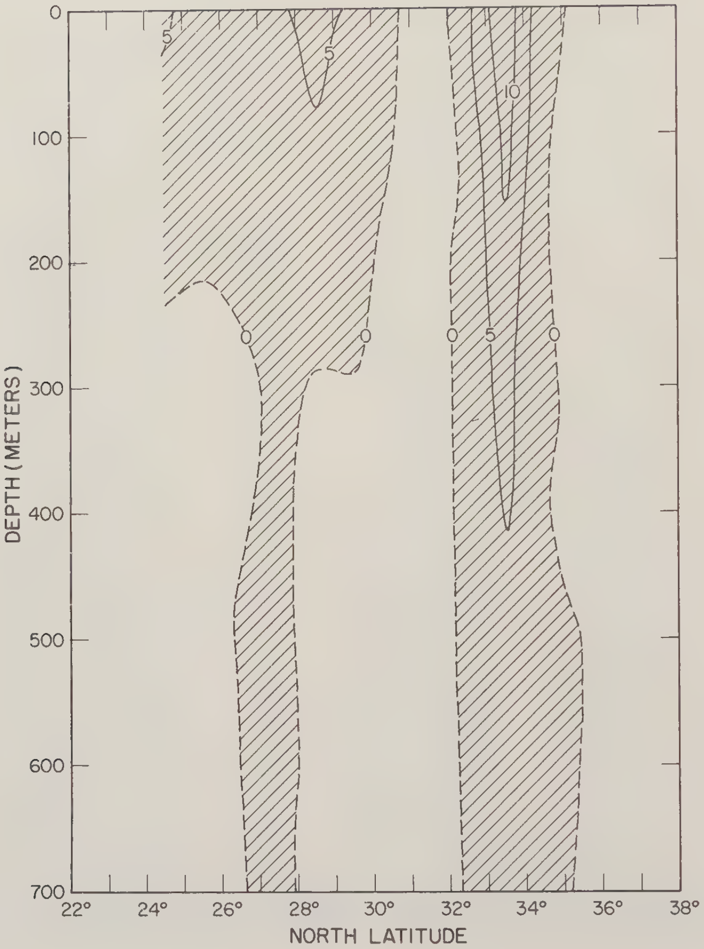


Figure 57.--Zonal components of the geostrophic currents in centimeters per second across 159° W. longitude; *Hugh M. Smith* cruise 27, January-February 1955. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

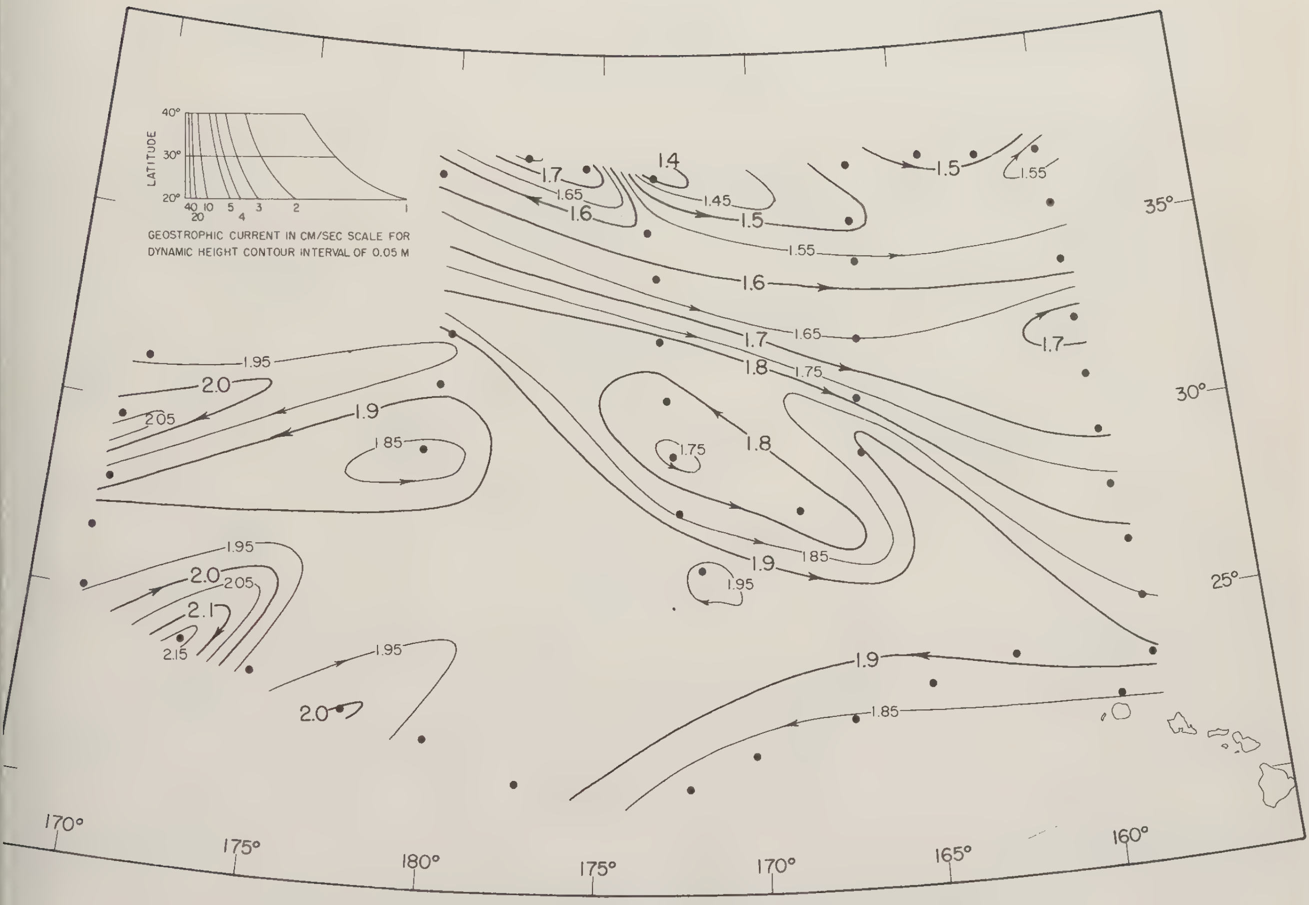

40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M
1.7
1.65
1.6
1.4
1.45
1.5
1.5
1.55
1.55
1.6
1.65
1.7
1.7
1.8
1.75
1.95
2.0
2.05
1.9
1.85
1.75
1.8
1.95
2.0
2.05
2.1
2.15
1.9
1.85
1.95
1.95
2.0
1.9
1.85
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 58.--Anomaly of the geopotential topography of the sea surface in dynamic meters relative to the 1,000-db. surface; *Hugh M. Smith* cruise 27, January-February 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

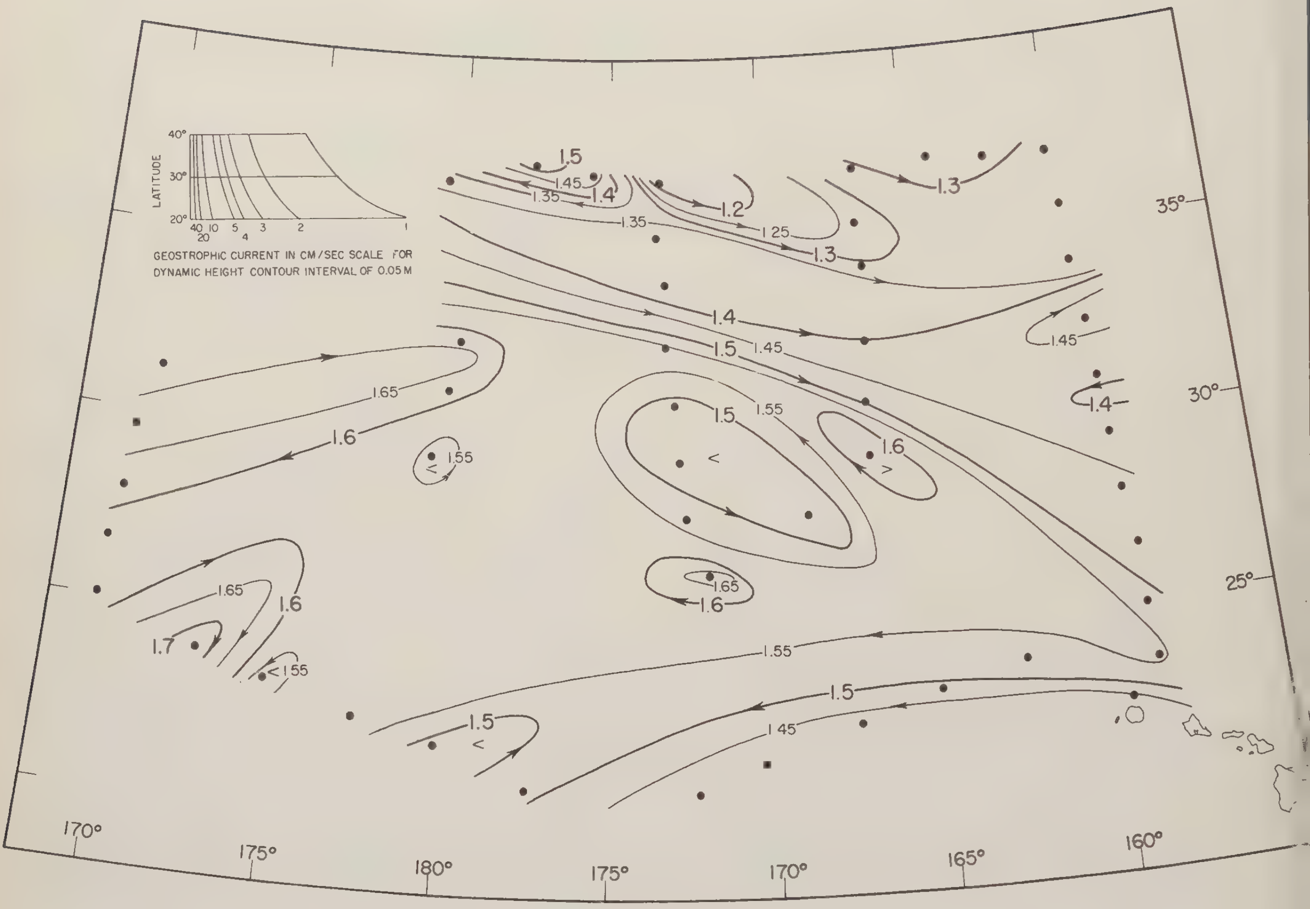

40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M
1.5
1.45
1.35
1.4
1.35
1.2
1.25
1.3
1.3
1.4
1.5
1.45
1.45
1.4
1.65
1.6
1.55
1.5
1.55
1.6
1.65
1.6
1.65
1.6
1.7
1.55
1.55
1.5
1.5
1.45
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 59.--Anomaly of the geopotential topography of the 100-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 27, January-February 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

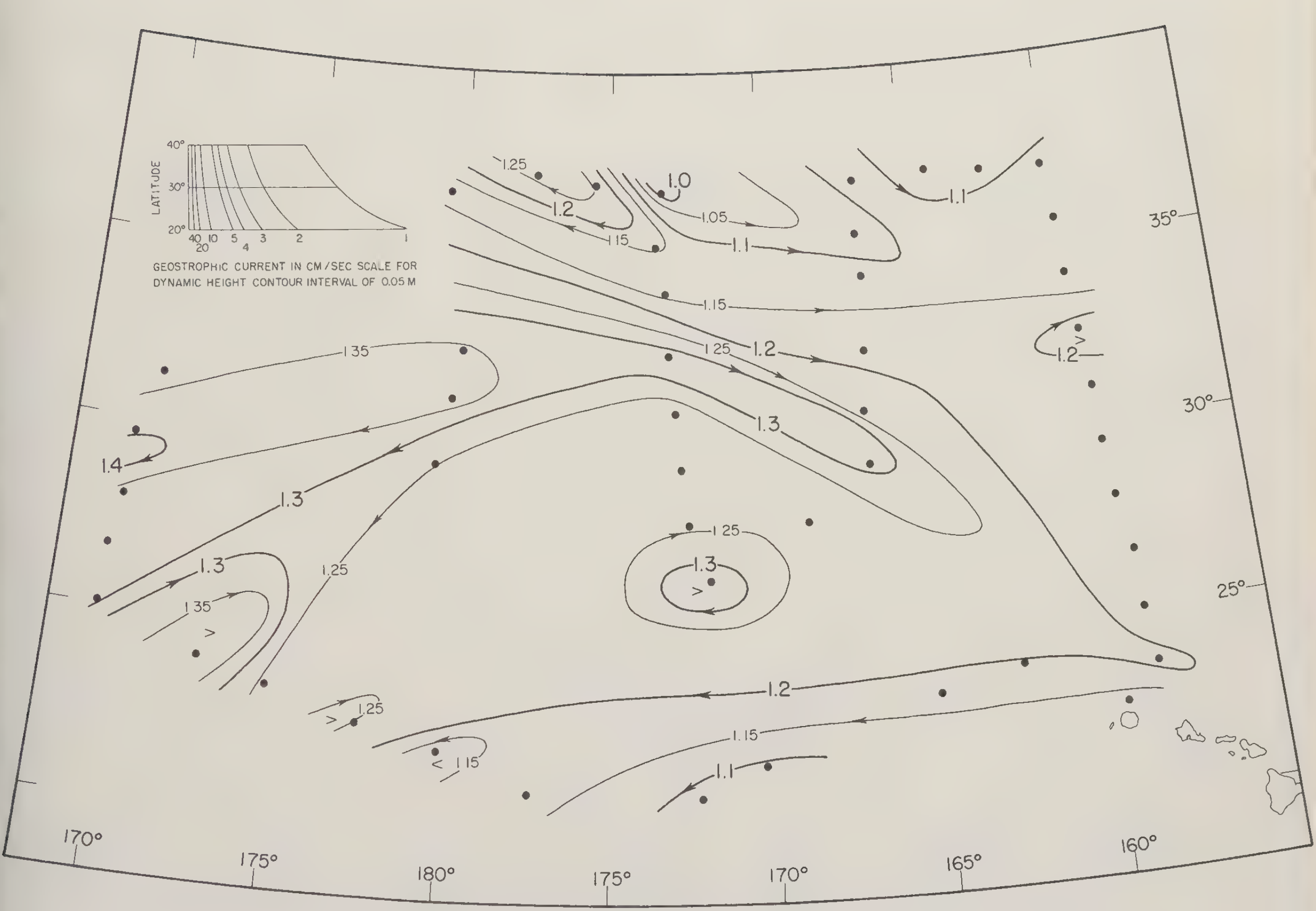

40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M
1.25
1.2
1.0
1.05
1.15
1.1
1.1
1.15
1.25
1.2
1.2
1.35
1.4
1.3
1.3
1.3
1.25
1.35
1.25
1.25
1.3
1.25
1.2
1.15
1.15
1.1
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 60.--Anomaly of the geopotential topography of the 200-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 27, January-February 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

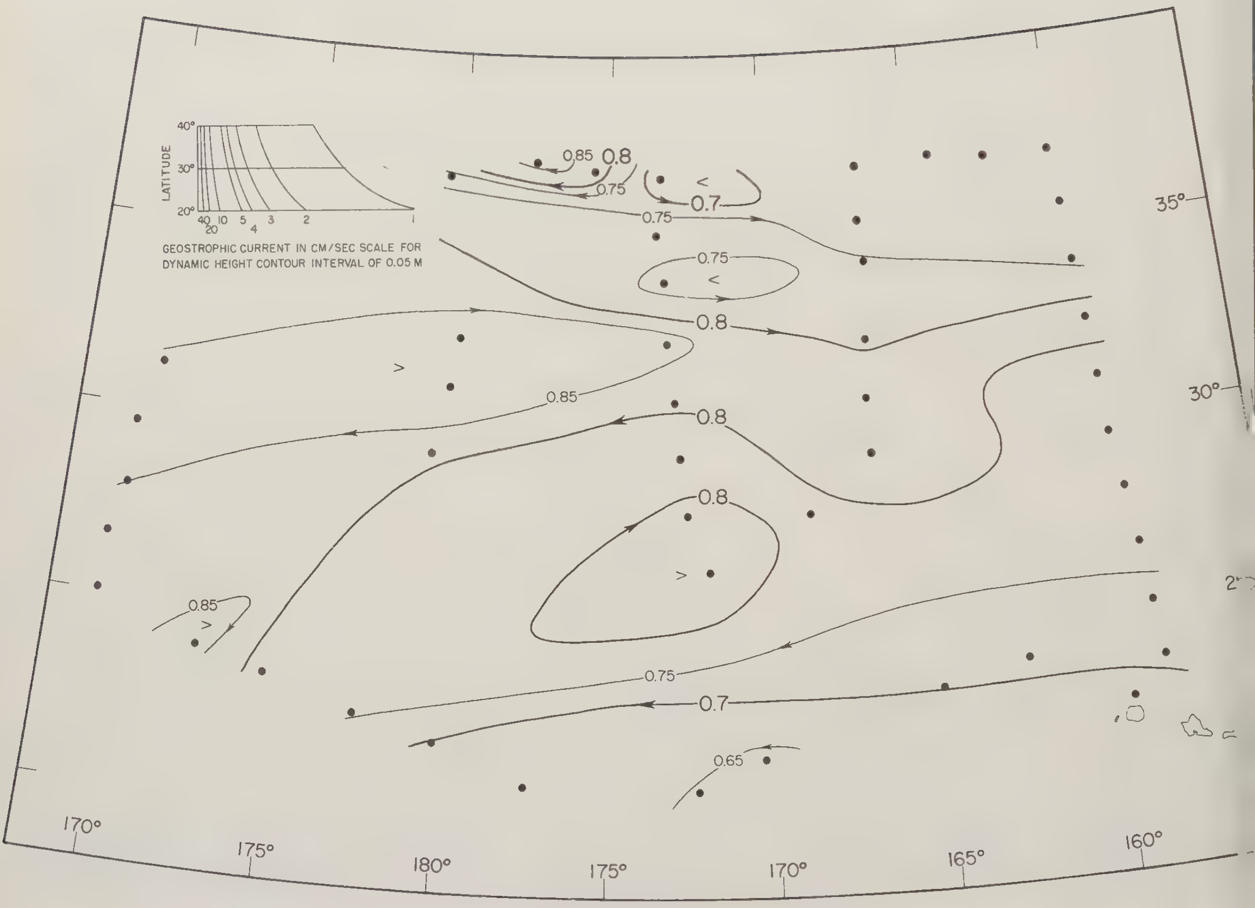

40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M
0.85
0.8
0.75
0.7
0.75
0.75
0.8
0.85
0.8
0.8
0.85
0.75
0.7
0.65
35°
30°
2
170°
175°
180°
175°
170°
165°
160°

Figure 61.--Anomaly of the geopotential topography of the 400-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 27, January-February 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

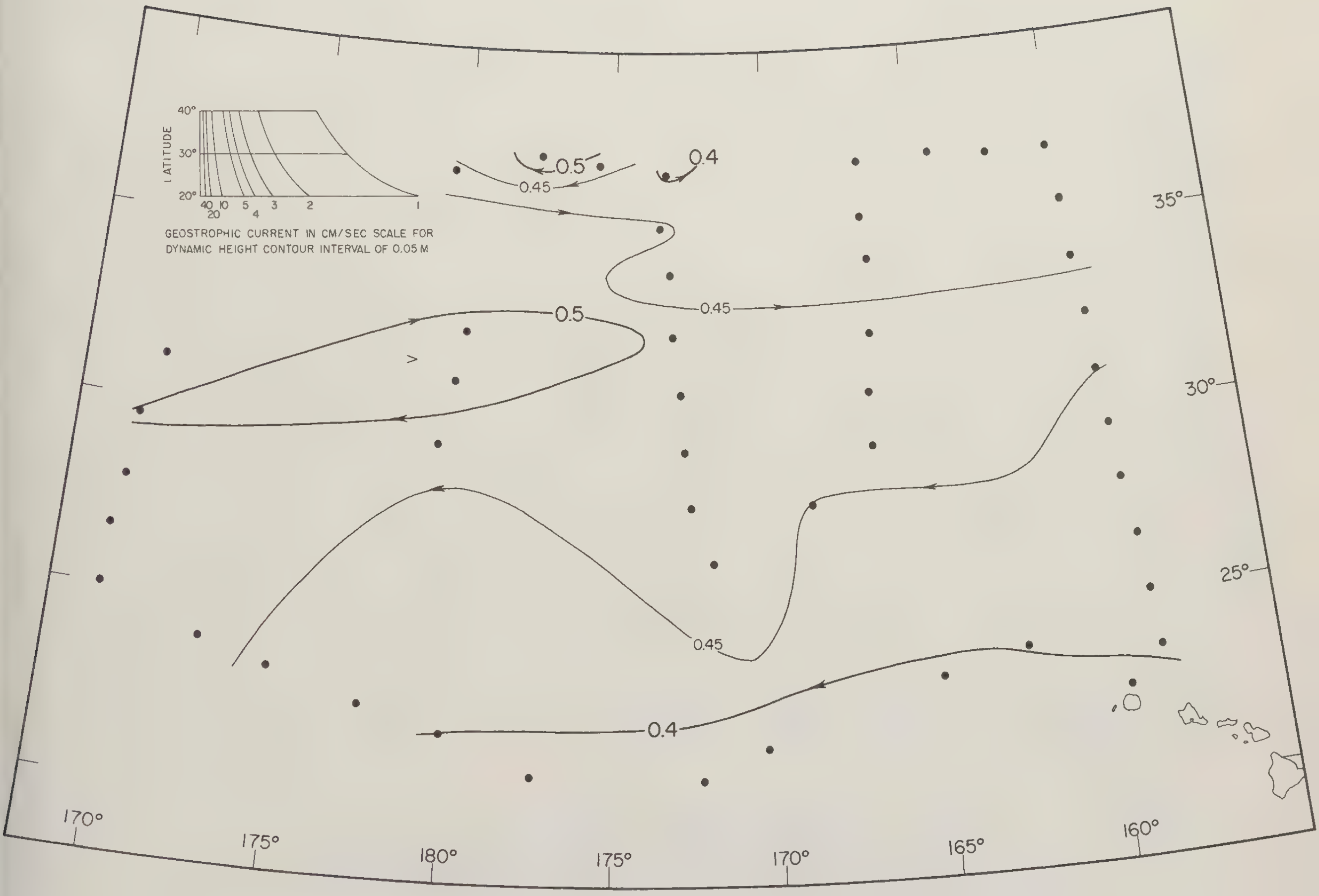
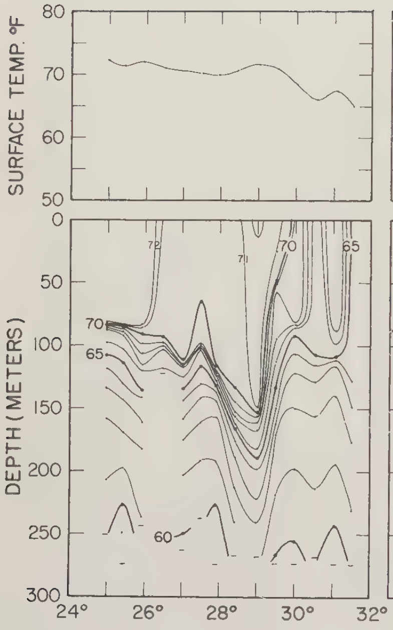
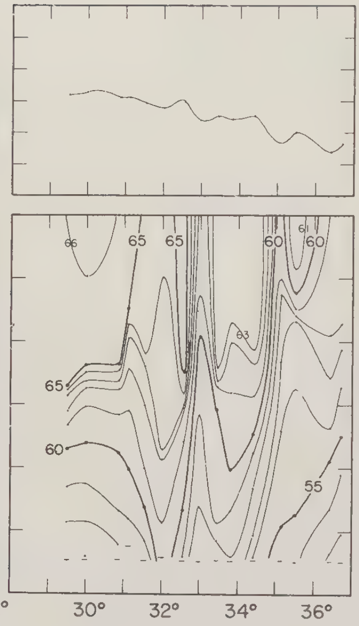

40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M
0.5
0.45
0.4
0.45
0.5
0.45
0.4
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 62.--Anomaly of the geopotential topography of the 600-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 27, January-February 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.





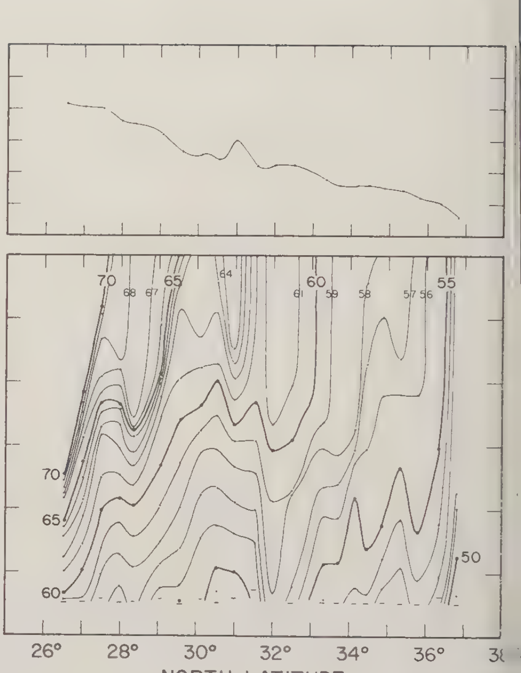
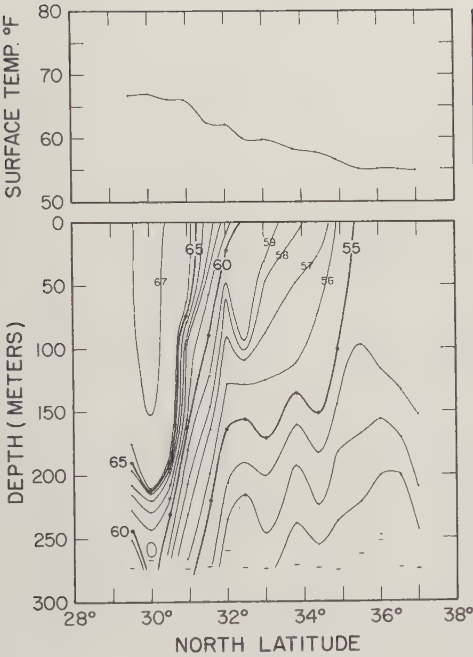


Figure 63.--Surface (bucket) temperatures (upper panel) and temperature-depth section (lower panel) in degrees Fahrenheit along 170°E. longitude from BT observations; Hugh M. Smith cruise 27, January-February 1955. Contour interval 1°F. Small dashes indicate the depth of lowering.

Figure 64.--Same along the 180th meridian.

Figure 65.--Same along 172°W. longitude.



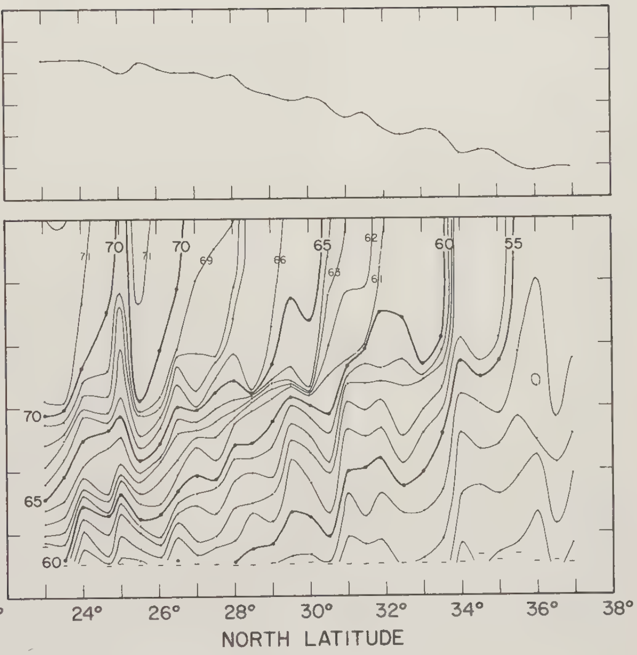


Figure 66.--Surface (bucket) temperatures (upper panel) and temperature-depth section (lower panel) in degrees Fahrenheit along 167°W. longitude from BT observations; Hugh M. Smith cruise 27, January-February 1955. Contour interval 1°F. Small dashes indicate the depth of lowering.

Figure 67.--Same along 159°W. longitude.

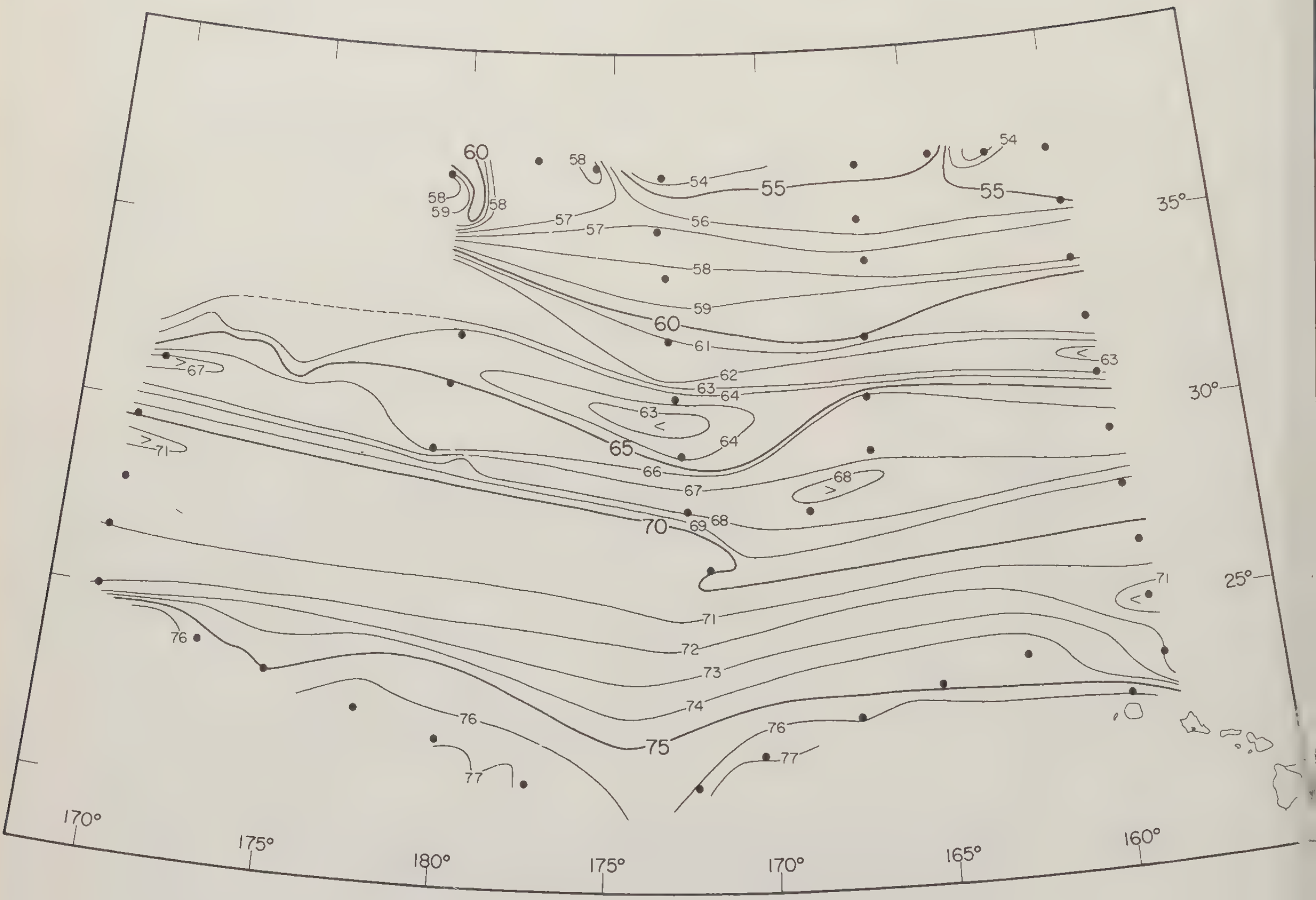
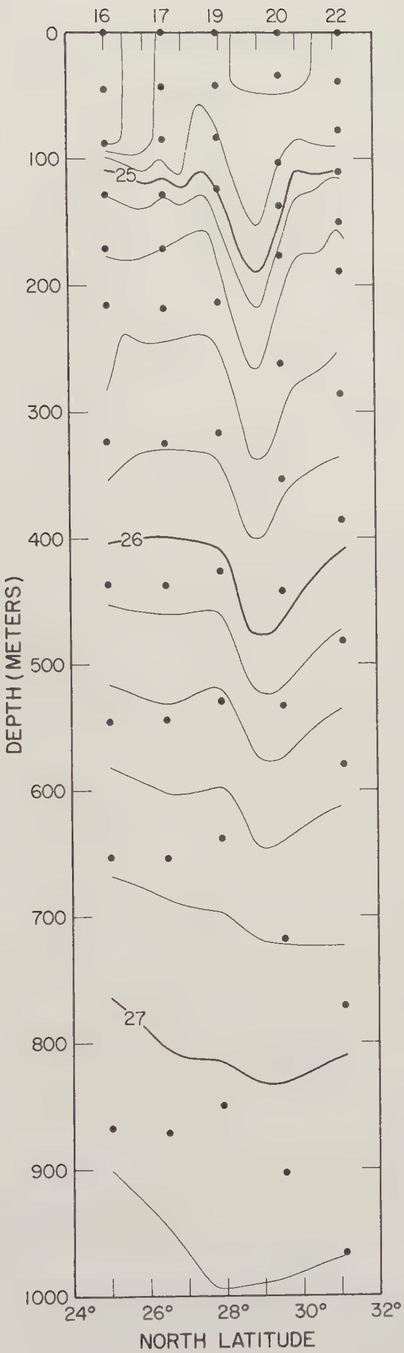

60
58
58
59
58
54
55
54
55
57
57
56
58
59
60
61
63
67
62
63
64
63
65
64
71
66
67
68
70
69
68
71
71
76
72
73
74
76
75
76
77
77
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 68.--Surface (bucket) temperatures in degrees Fahrenheit; Hugh M. Smith cruise 27, January-February 1955. Contour interval 1°F.



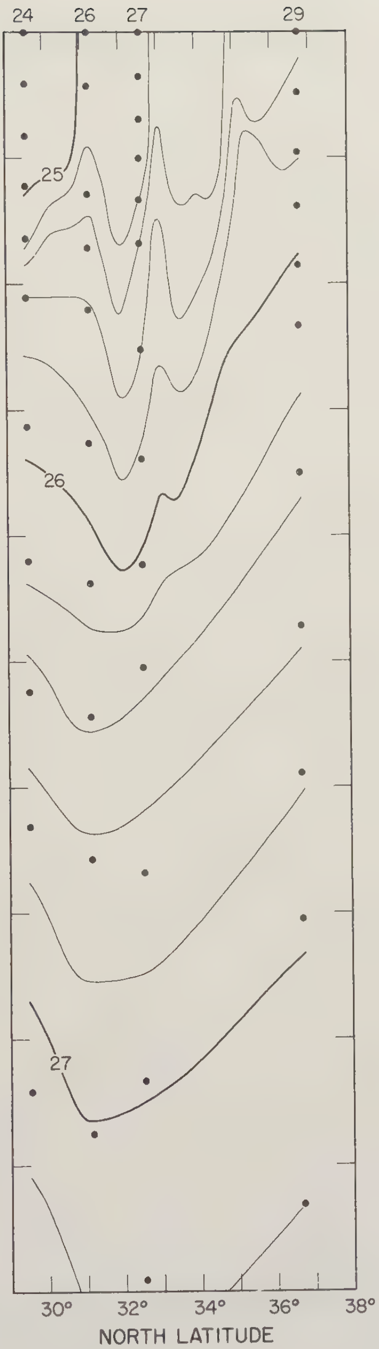
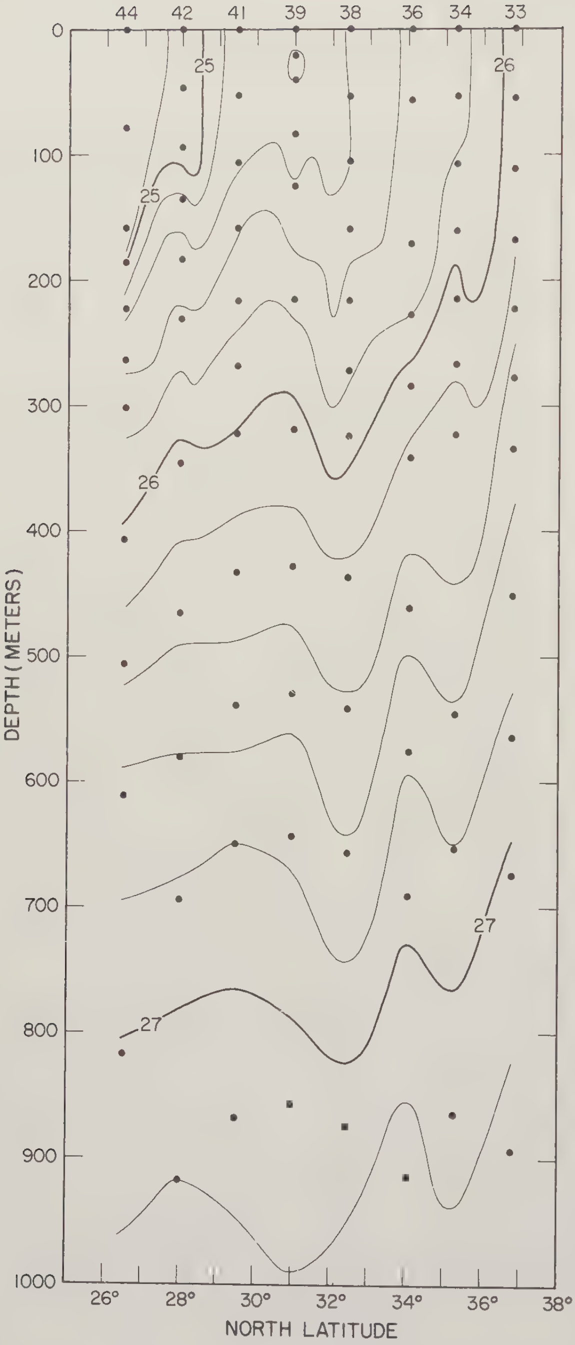


Figure 69.--Vertical section of sigma-t along 170°E. longitude; Hugh M. Smith cruise 27, stations 16-22, January-February 1955. Contour interval 0.2. Points indicate observed values.

Figure 70.--Same along 180th meridian, stations 24-29.



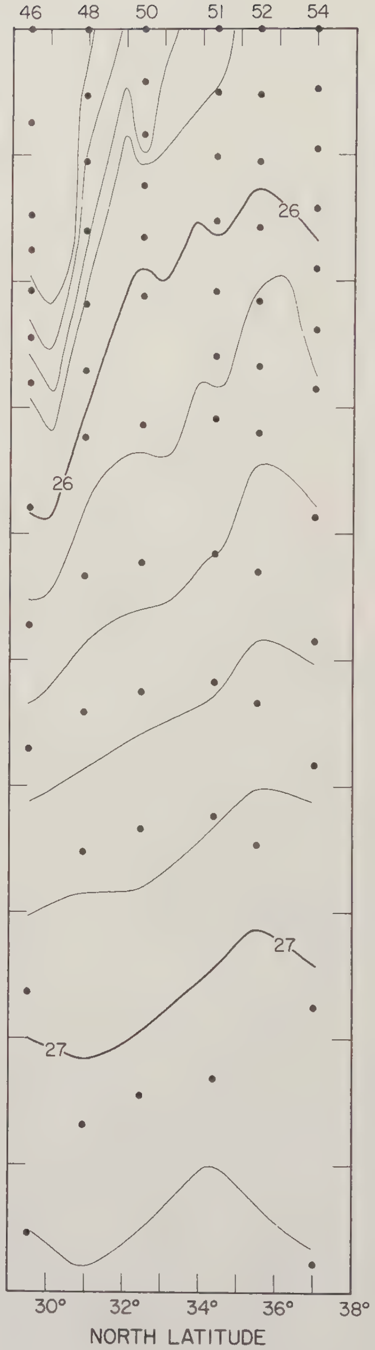


Figure 71.--Vertical section of sigma-t along 172°W. longitude; Hugh M. Smith cruise 27, stations 33-44, January-February 1955. Contour interval 0.2. Points indicate observed values.

Figure 72.--Same along 167°W. longitude, stations 46-54.

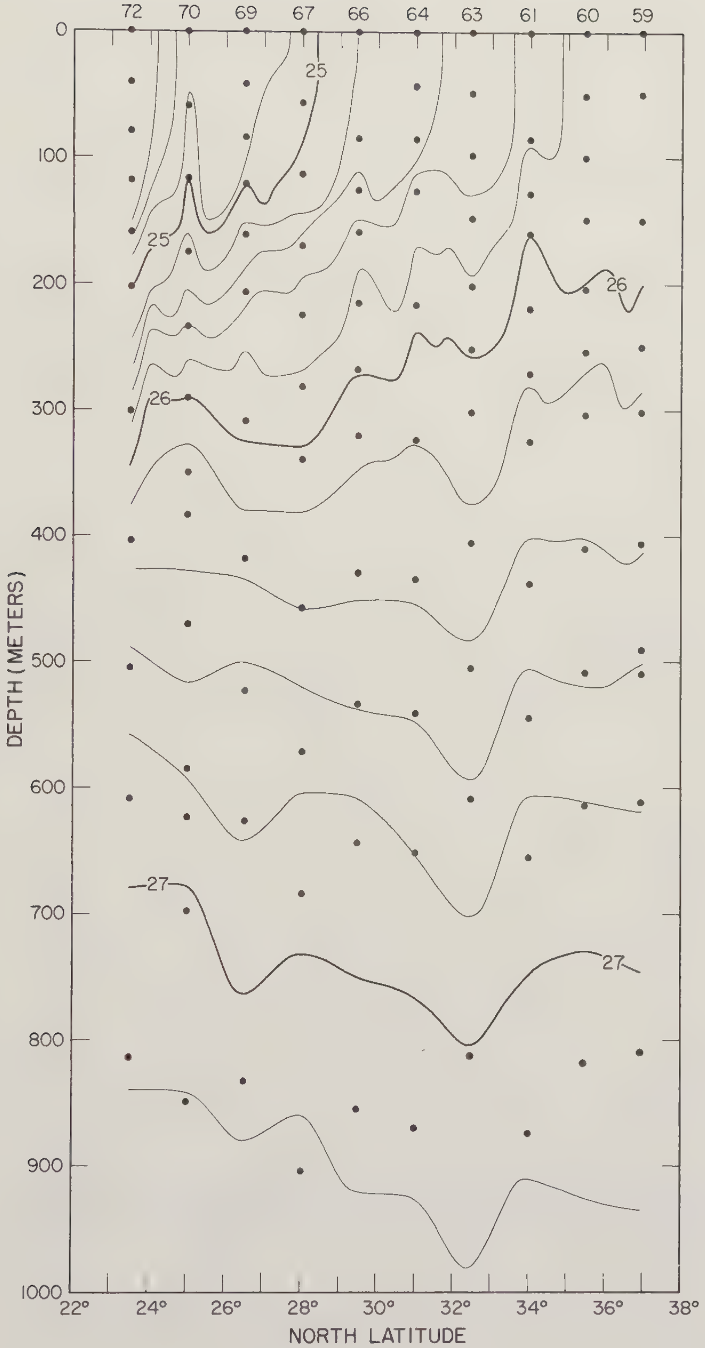


Figure 73.--Vertical section of sigma-t along 159°W. longitude; *Hugh M. Smith* cruise 27, stations 59-72, January-February 1955. Contour interval 0.2. Points indicate observed values.

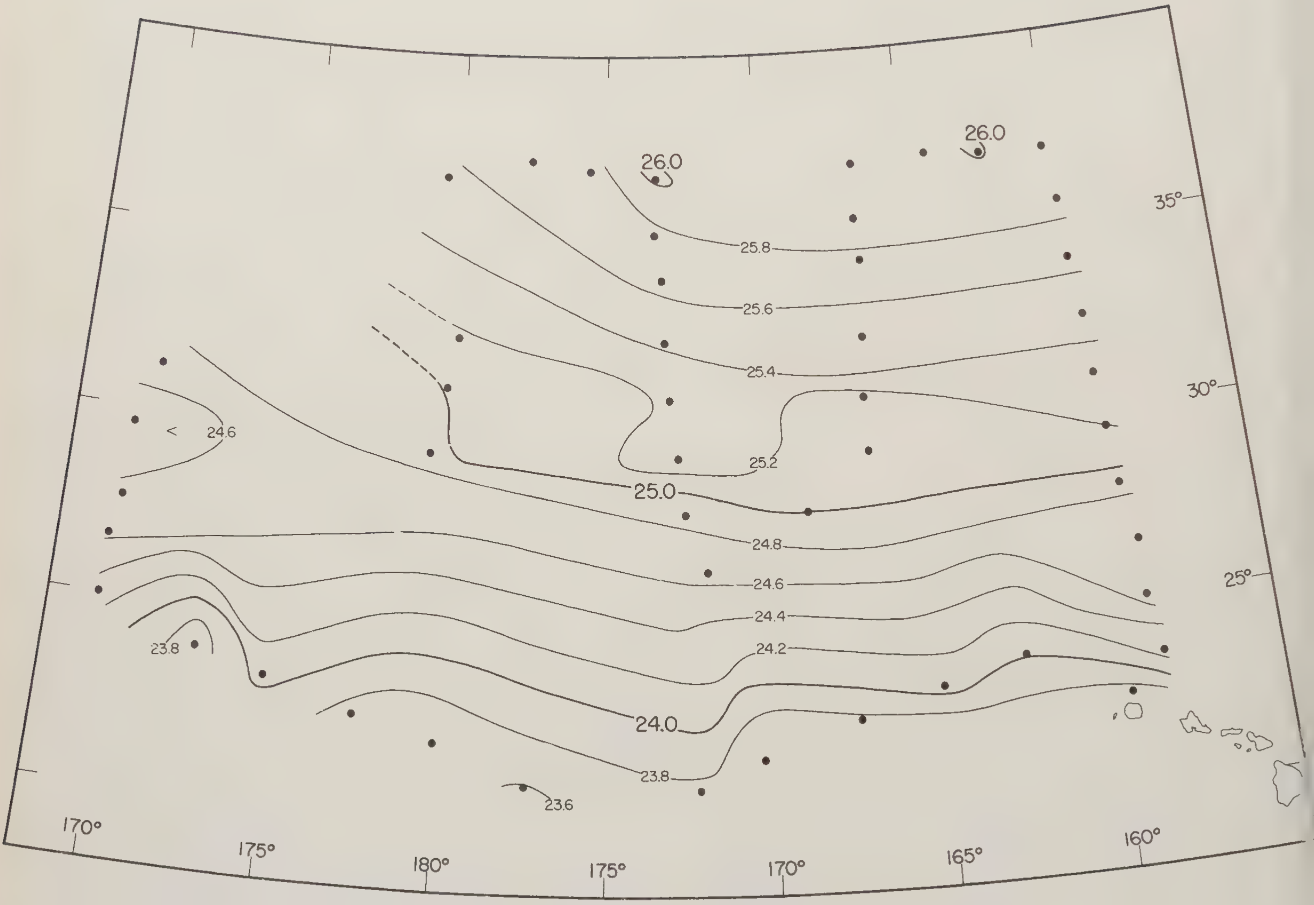

26.0
26.0
35°
25.8
25.6
25.4
30°
24.6
25.2
25.0
24.8
24.6
25°
24.4
24.2
23.8
24.0
23.8
23.6
170°
175°
180°
175°
170°
165°
160°

Figure 74.--Surface sigma-t; Hugh M. Smith cruise 27, January-February 1955. Contour interval 0.2. Dots indicate station positions.

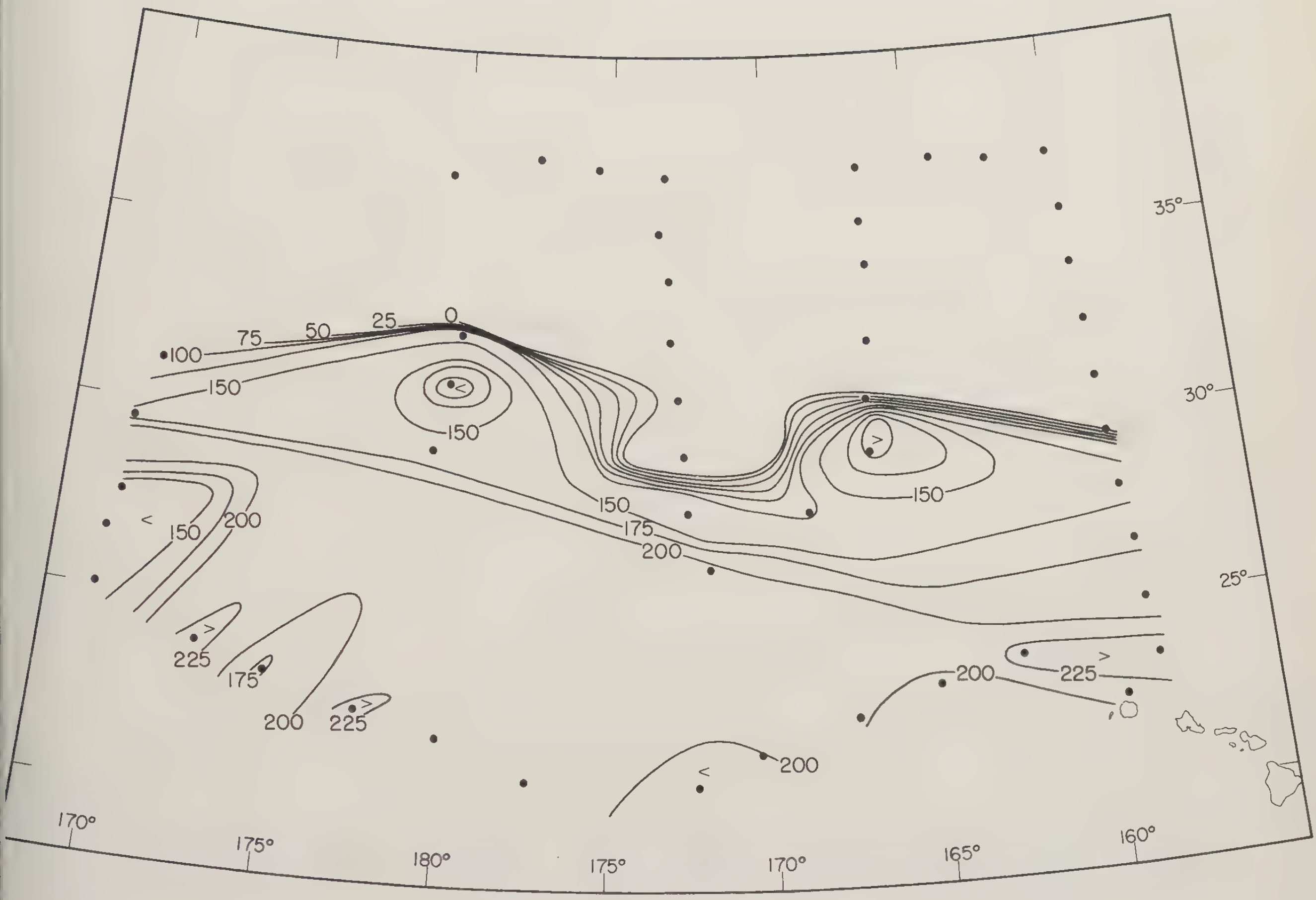

35°
30°
25°
170°
175°
180°
175°
170°
165°
160°
0
25
50
75
100
150
150
150
175
200
150
200
225
175
200
225
150
200
225
200
<
>
<
>
>
<

Figure 75.--Depth of the 25.2 sigma-t surface in meters; Hugh M. Smith cruise 27, January-February 1955. Contour interval 25 m. Dots indicate station positions.

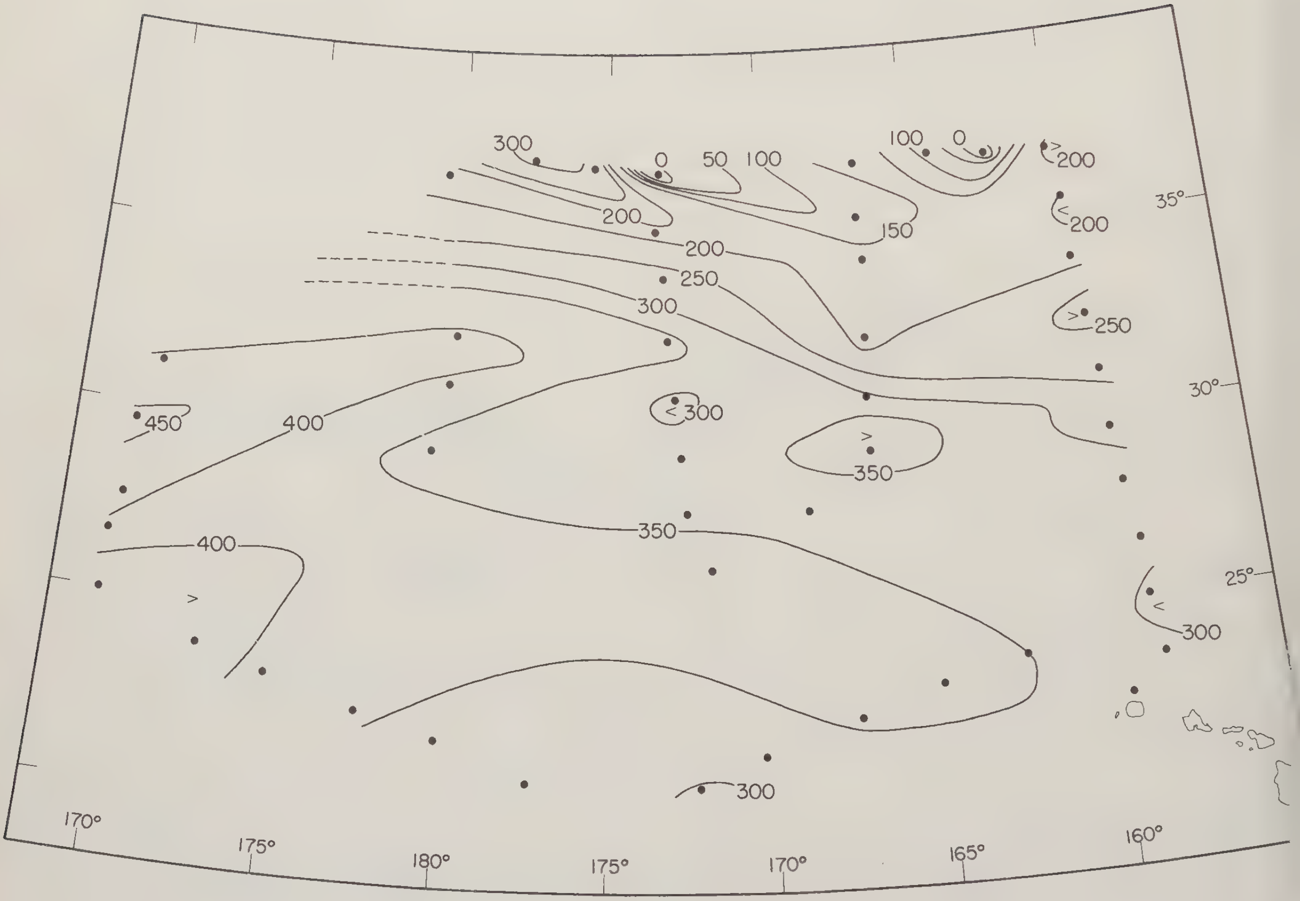

300
0
50
100
100
0
200
200
200
150
200
35°
200
250
250
300
30°
450
400
300
350
350
400
25°
300
300
170°
175°
180°
175°
170°
165°
160°

Figure 76.--Depth of the 26.0 sigma-t surface in meters; Hugh M. Smith cruise 27, January-February 1955. Contour interval 50 m. Dots indicate station positions.

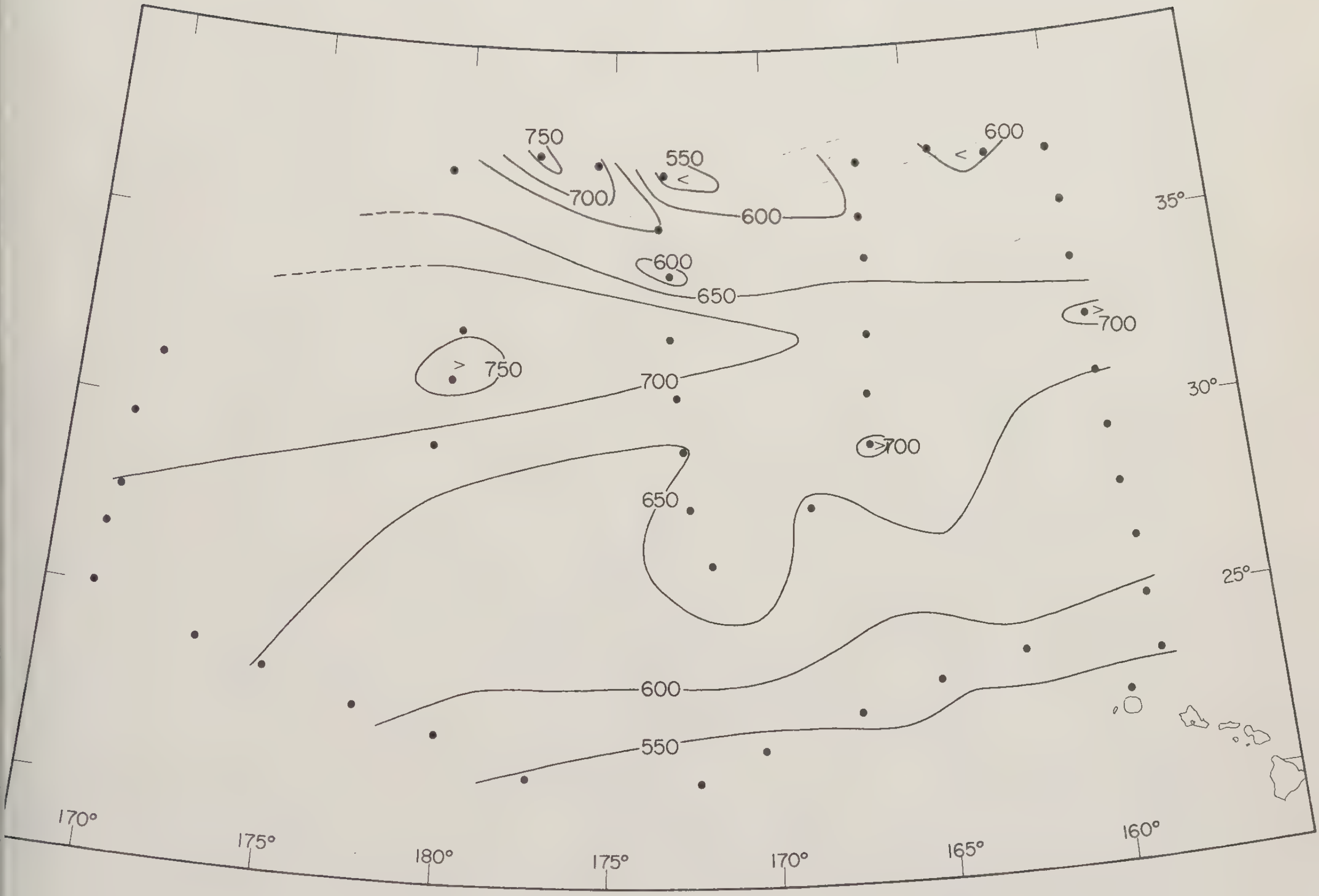
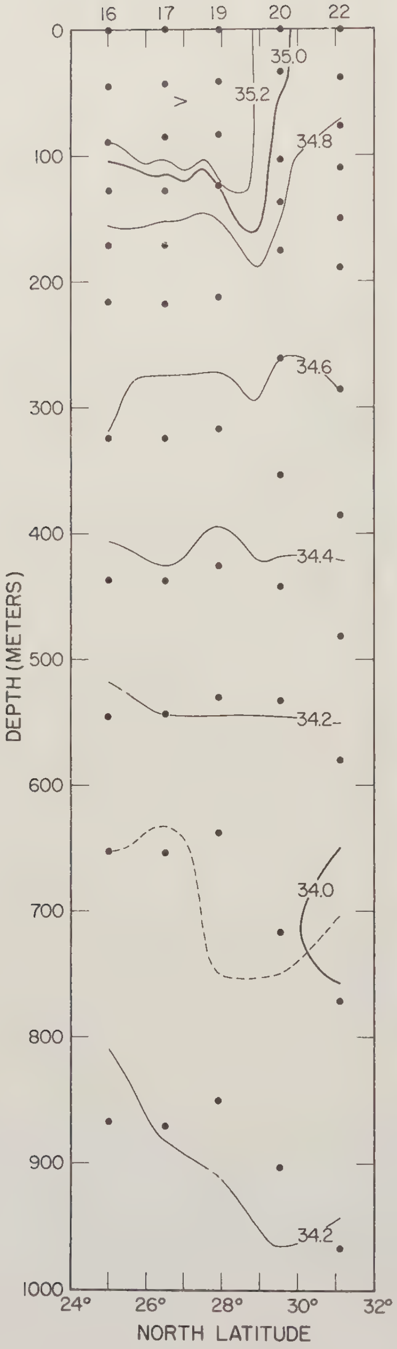

750
550
600
700
600
600
650
700
750
700
700
650
600
550
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 77.--Depth of the 26.8 sigma-t surface in meters; Hugh M. Smith cruise 27, January-February 1955. Contour interval 50 m. Dots indicate station positions.



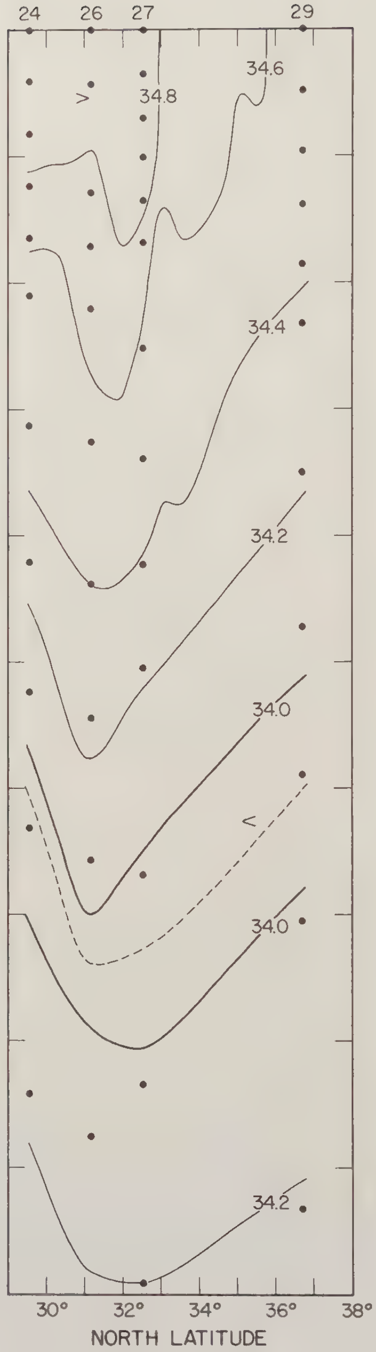
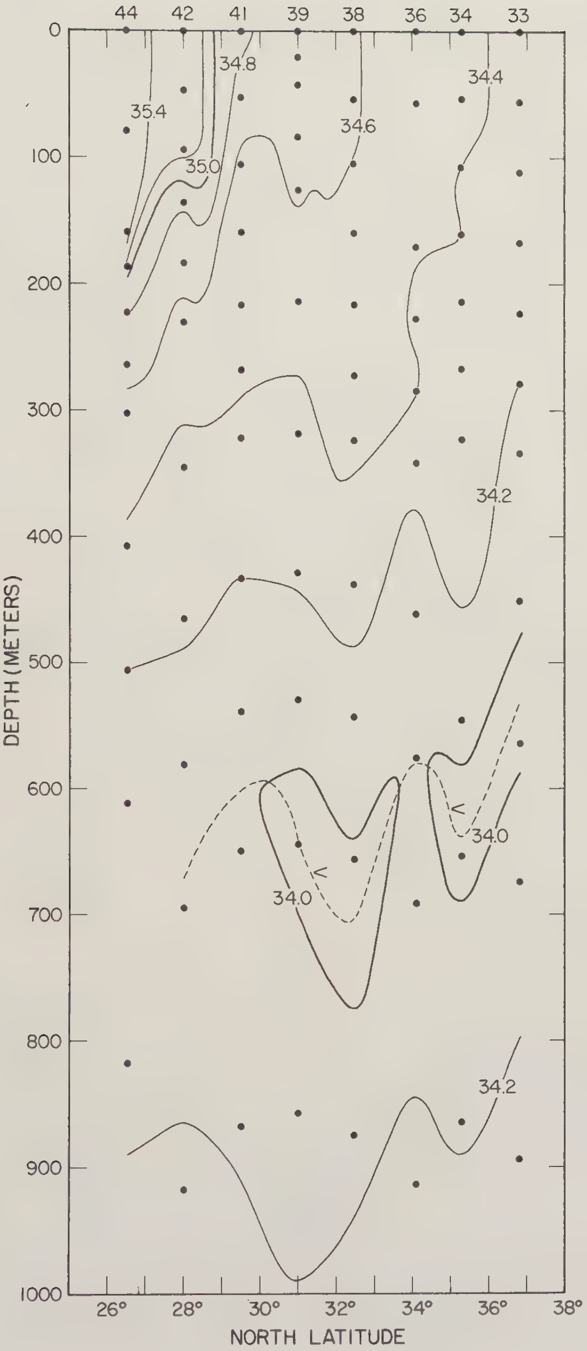


Figure 78.--Vertical section of salinity in parts per thousand along 170° E. longitude; Hugh M. Smith cruise 27, stations 16-22, January-February 1955. Points indicate observed values. Dotted lines indicate depth of salinity minima.

Figure 79.--Same along 180th meridian, stations 24-29.



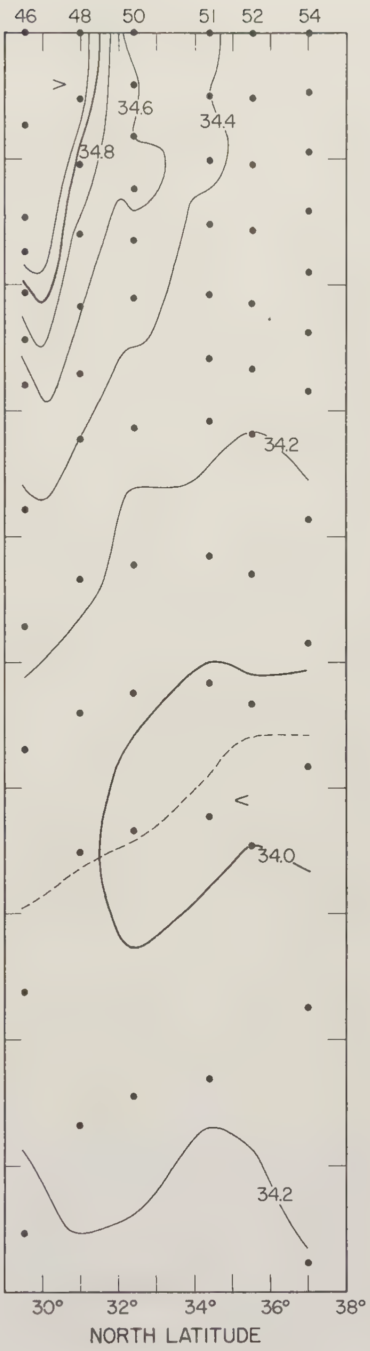


Figure 80.--Vertical section of salinity in parts per thousand along 172°W. longitude; Hugh M. Smith cruise 27, stations 33-44, January-February 1955. Points indicate observed values. Dotted lines indicate depth of salinity minima.

Figure 81.--Same along 167°W. longitude, stations 46-54.

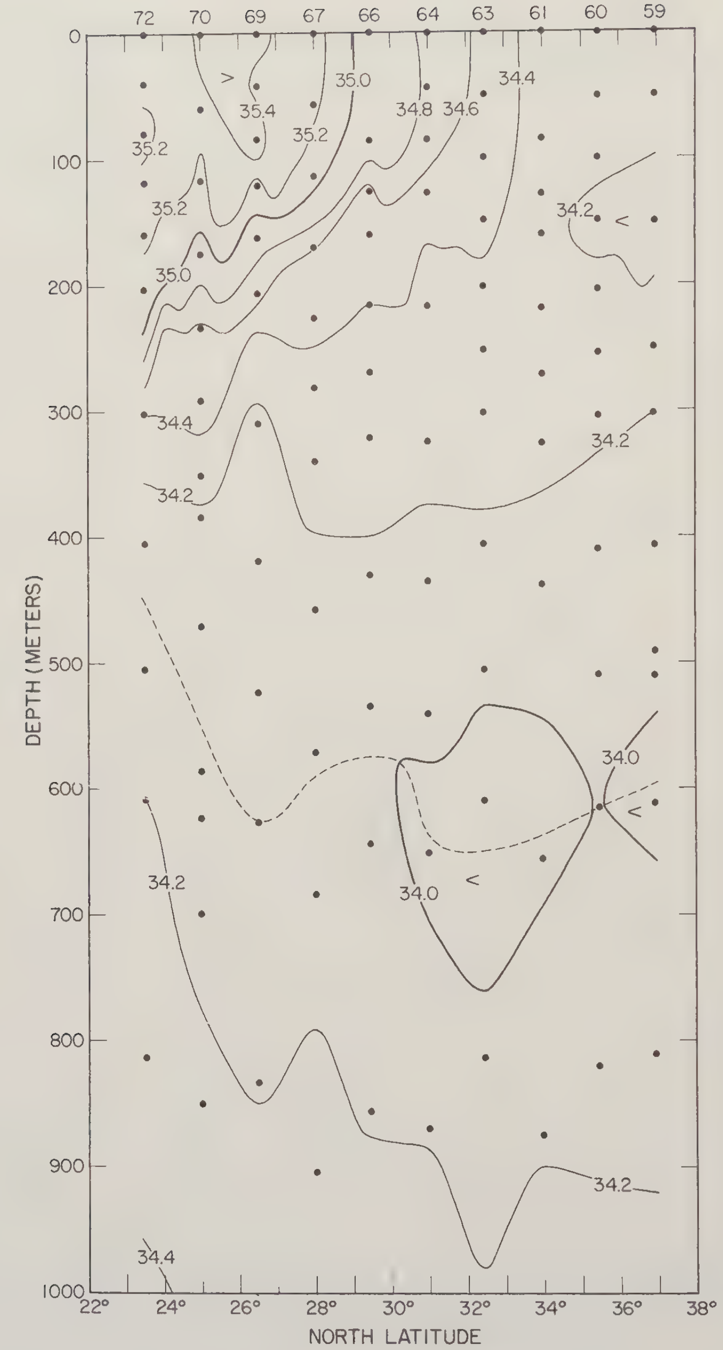


Figure 82.--Vertical section of salinity in parts per thousand along 159° W. longitude; Hugh M. Smith cruise 27, stations 59-72, January-February 1955. Points indicate observed values. Dotted lines indicate depth of salinity minima.

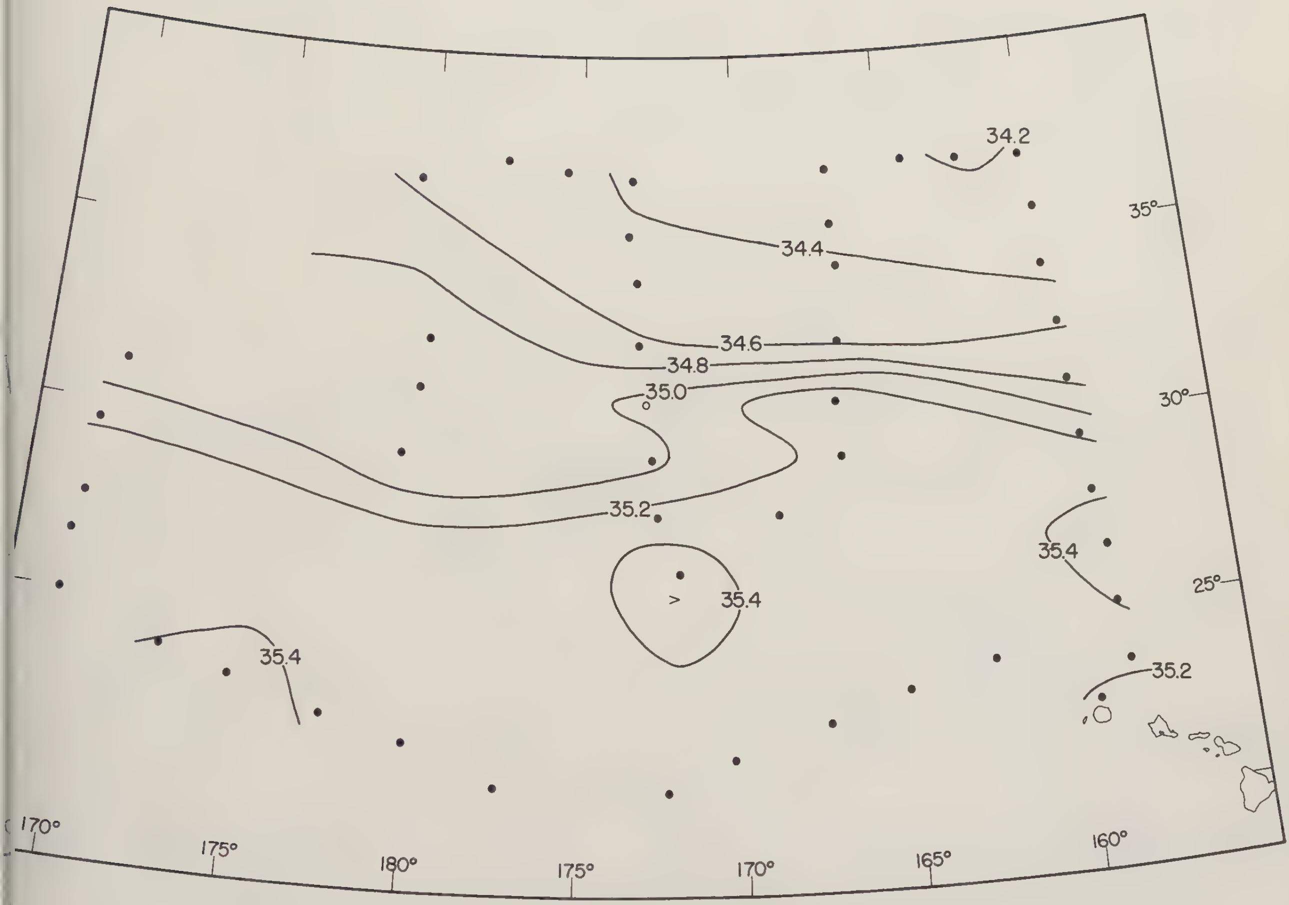

34.2
34.4
34.6
34.8
35.0
35.2
35.4
35.4
35.4
35.2
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 83.--Surface salinity in parts per thousand; Hugh M. Smith cruise 27, January-February 1955. Contour interval 0.2 ‰. Dots indicate observed values.

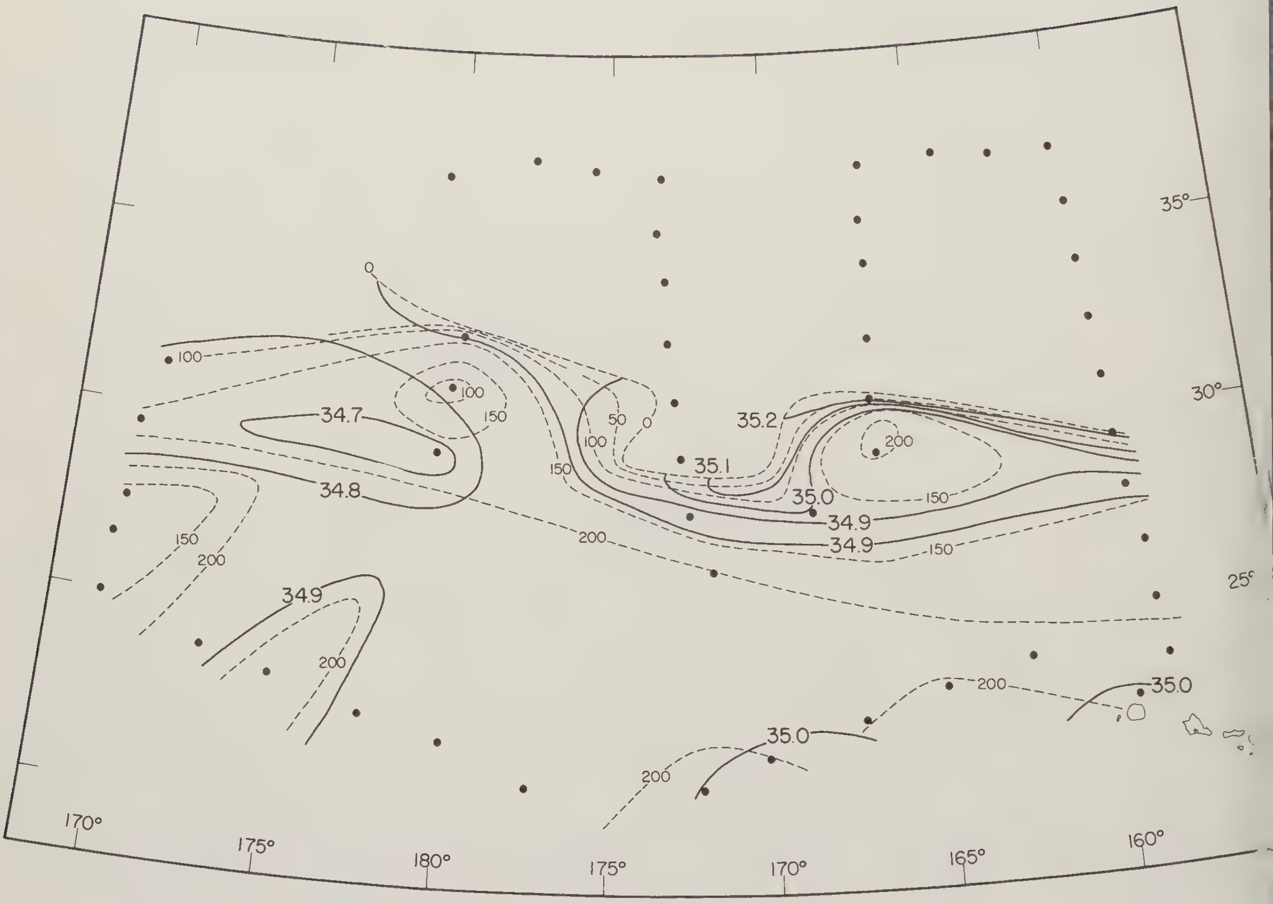

35°
30°
25°
0
100
100
150
34.7
50
0
100
150
35.2
200
35.1
34.8
35.0
34.9
150
34.9
150
150
200
200
34.9
200
200
35.0
35.0
200
170°
175°
180°
175°
170°
165°
160°

Figure 84.--Salinity in parts per thousand (solid lines) on the 25.2 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: salinity 0.1 ‰, depth of sigma-t surface 50 m. Dots indicate station positions.

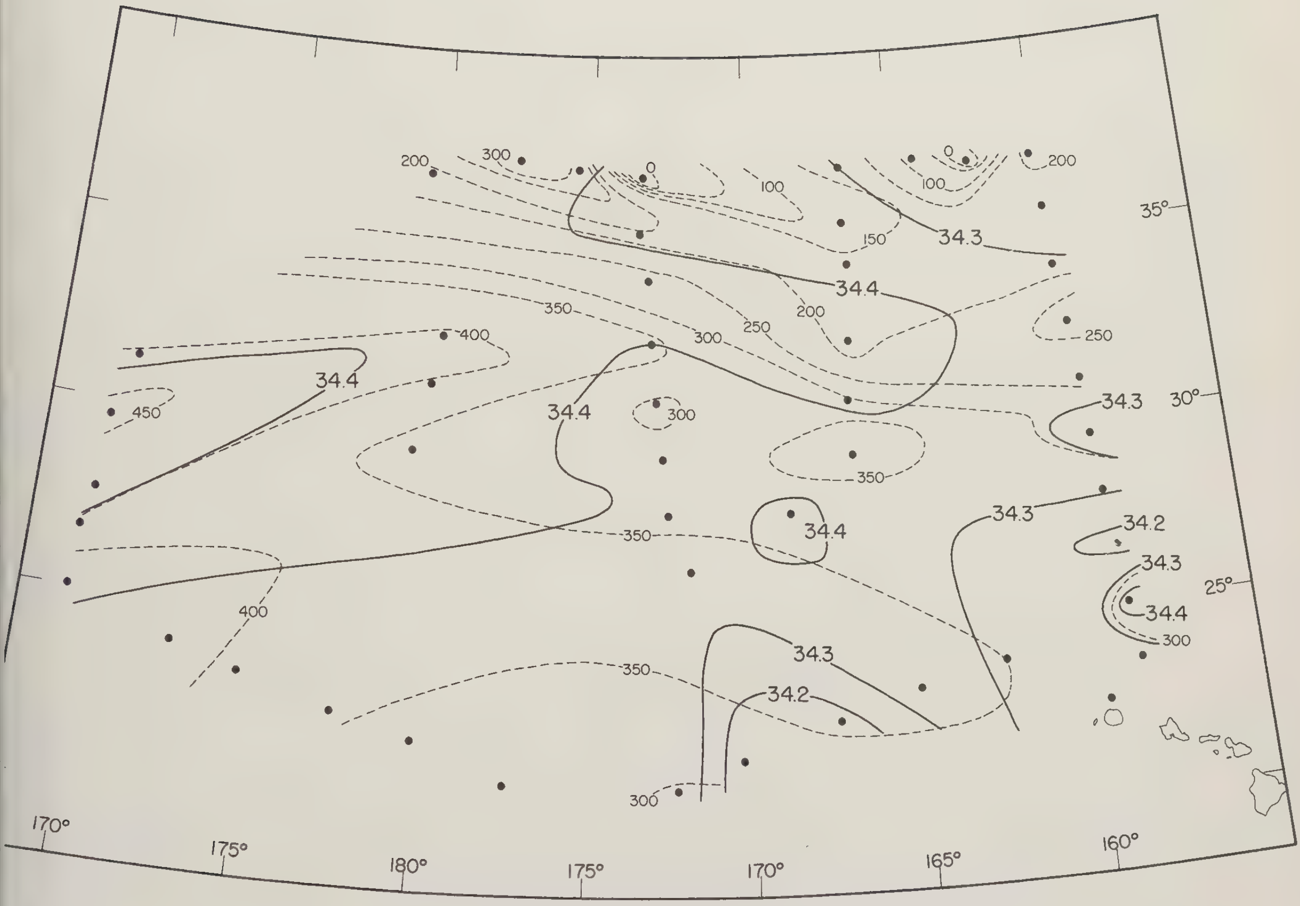

200
300
0
100
0
100
200
35°
150
34.3
34.4
200
250
350
300
250
400
34.4
34.4
300
34.3
30°
450
350
34.3
34.2
34.4
350
34.3
25°
34.4
300
400
34.3
350
34.2
300
170°
175°
180°
175°
170°
165°
160°

Figure 85.--Salinity in parts per thousand (solid lines) on the 26.0 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: salinity 0.1 ‰, depth of sigma-t surface 50 m. Dots indicate station positions.

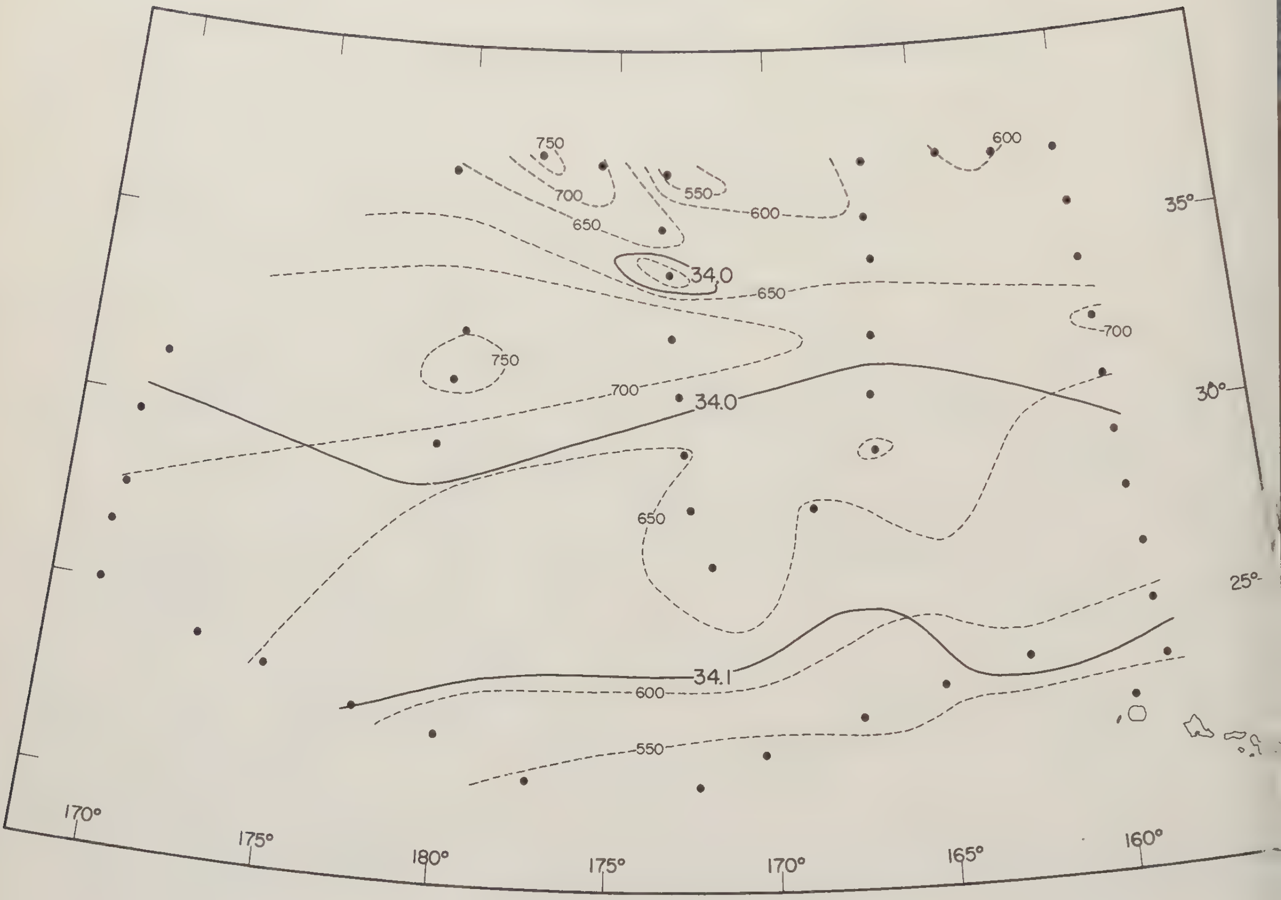
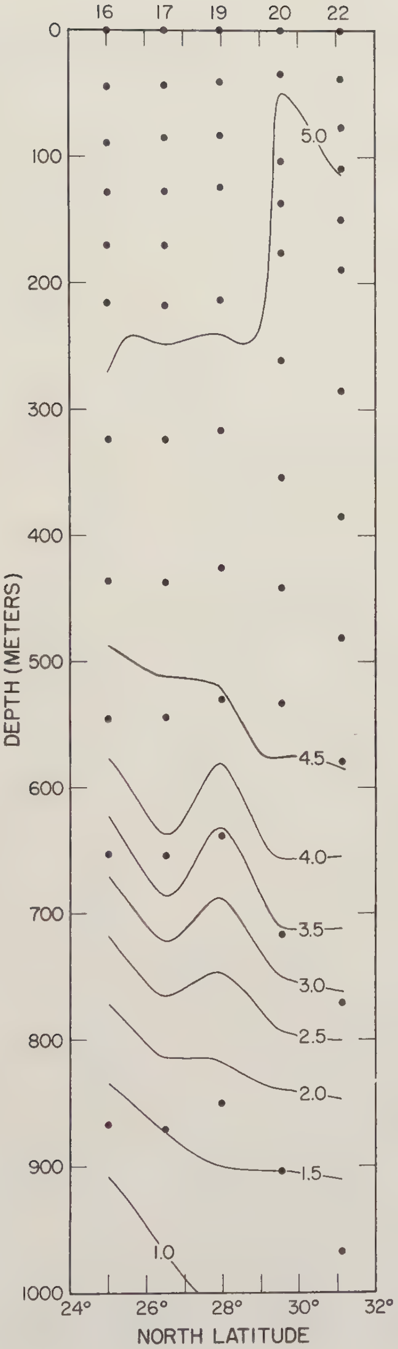

750
600
35°
700
550
650
600
34.0
650
700
750
30°
700
34.0
650
25°
34.1
600
550
170°
175°
180°
175°
170°
165°
160°

Figure 86. --Salinity in parts per thousand (solid lines) on the 26.8 sigma-t surface (depth in meters, dotted lines); *Hugh M. Smith* cruise 27, January-February 1955. Contour intervals: salinity 0.1 ‰, depth of sigma-t surface 50 m. Dots indicate station positions.



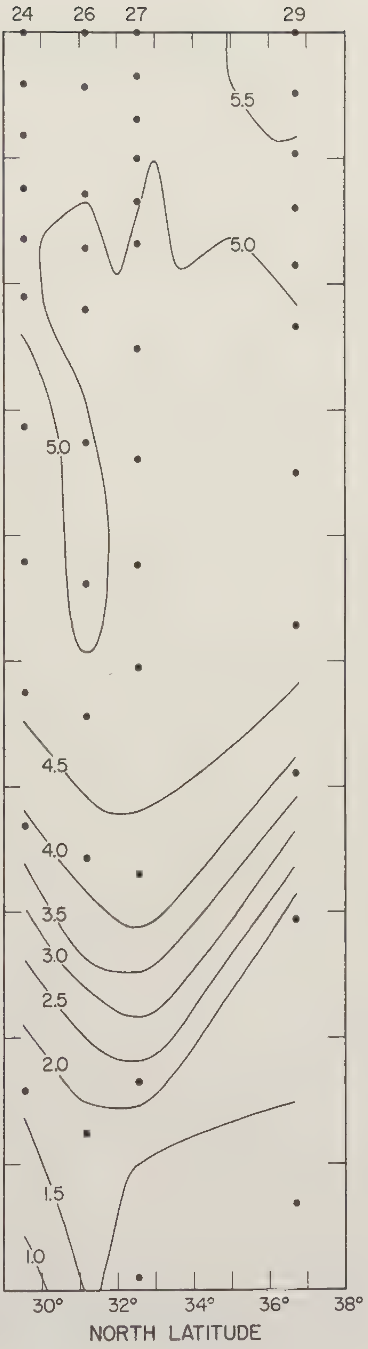
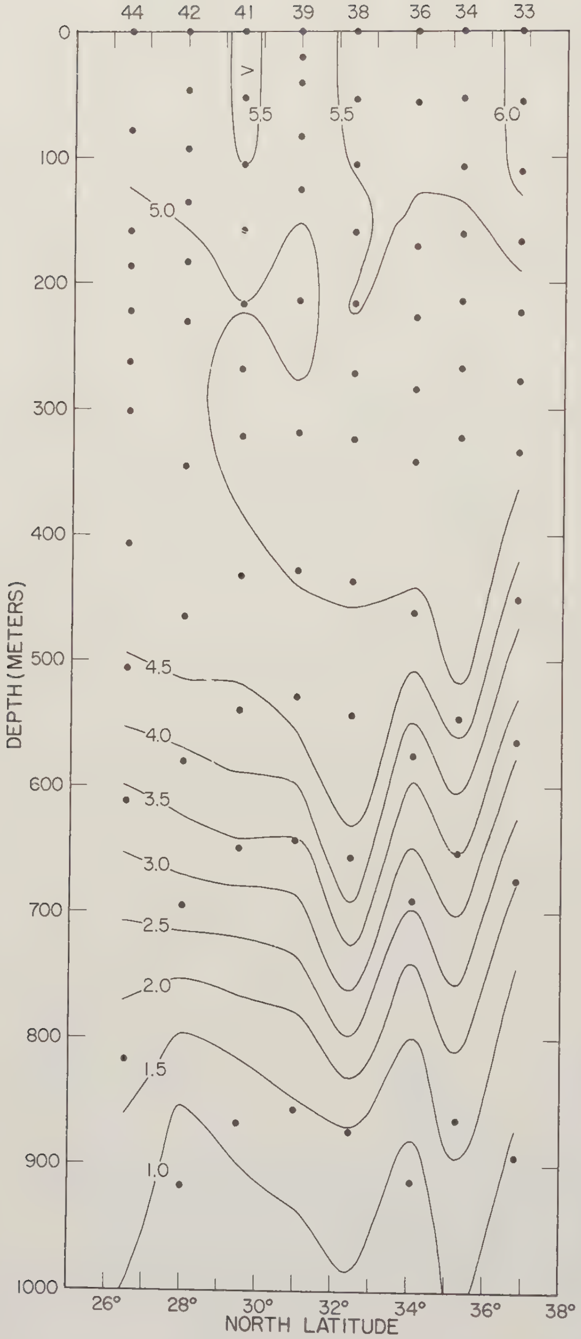


Figure 87.--Vertical section of dissolved oxygen in milliliters per liter along 170°E. longitude; Hugh M. Smith cruise 27, stations 16-22, January-February 1955. Contour interval 0.5 ml./l.

Figure 88.--Same along the 180th meridian, stations 24-29.



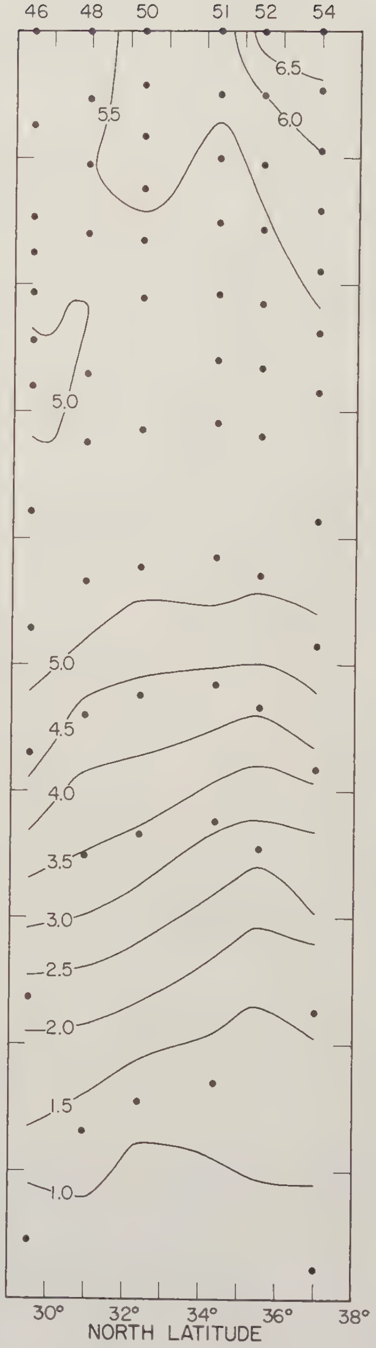


Figure 89.--Vertical section of dissolved oxygen in milliliters per liter along 172°W. longitude; *Hugh M. Smith* cruise 27, stations 33-44, January-February 1955. Contour interval 0.5 ml./l.

Figure 90.--Same along 167°W. longitude, stations 46-54.

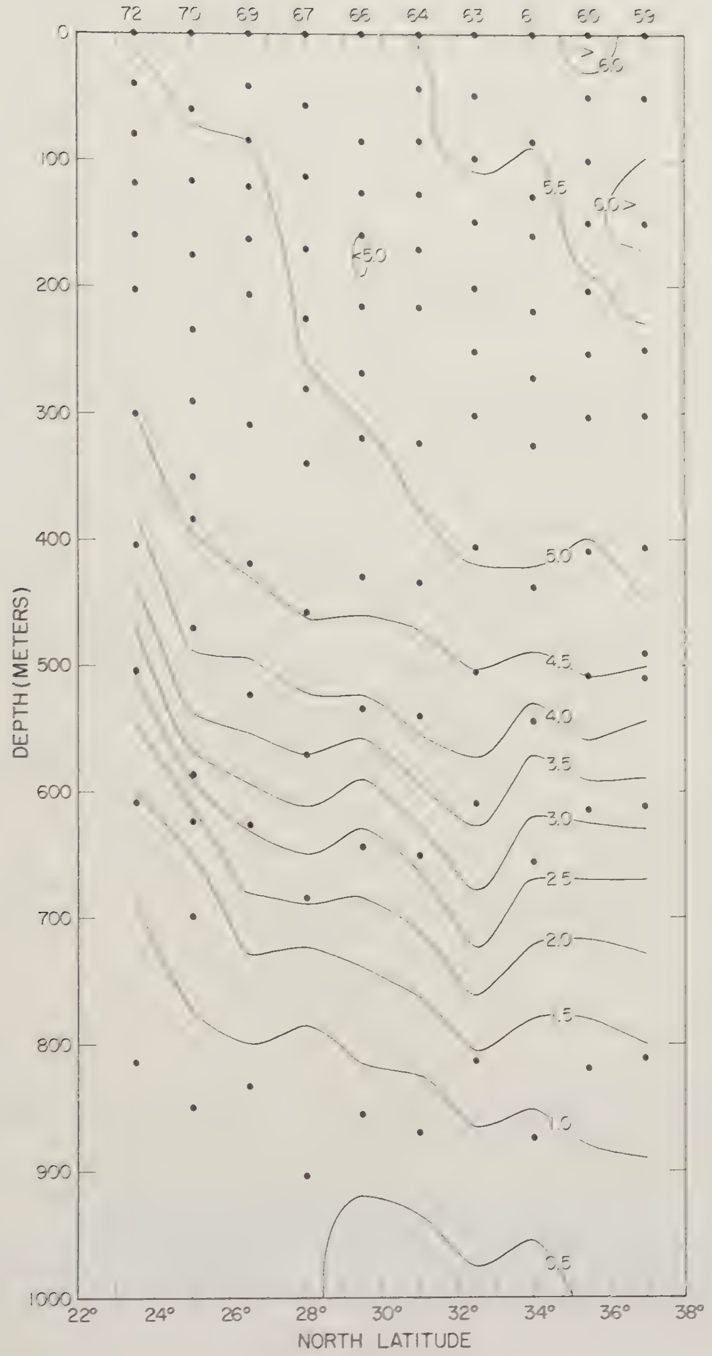


Figure 91.--Vertical section of dissolved oxygen in milliliters per liter along 159°W. longitude; Hugh M. Smith cruise 27, stations 59-72, January-February 1955. Contour interval 0.5 ml./l.

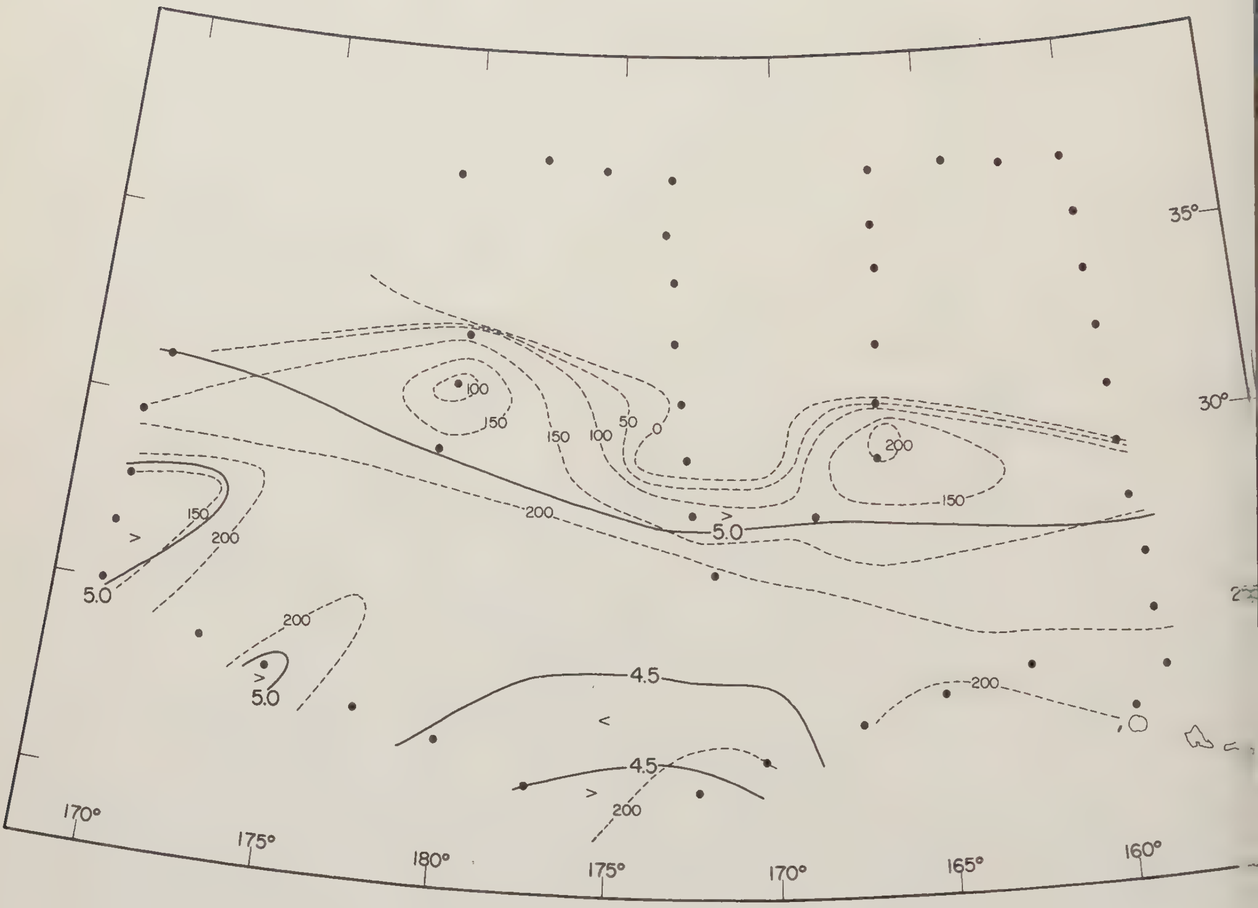
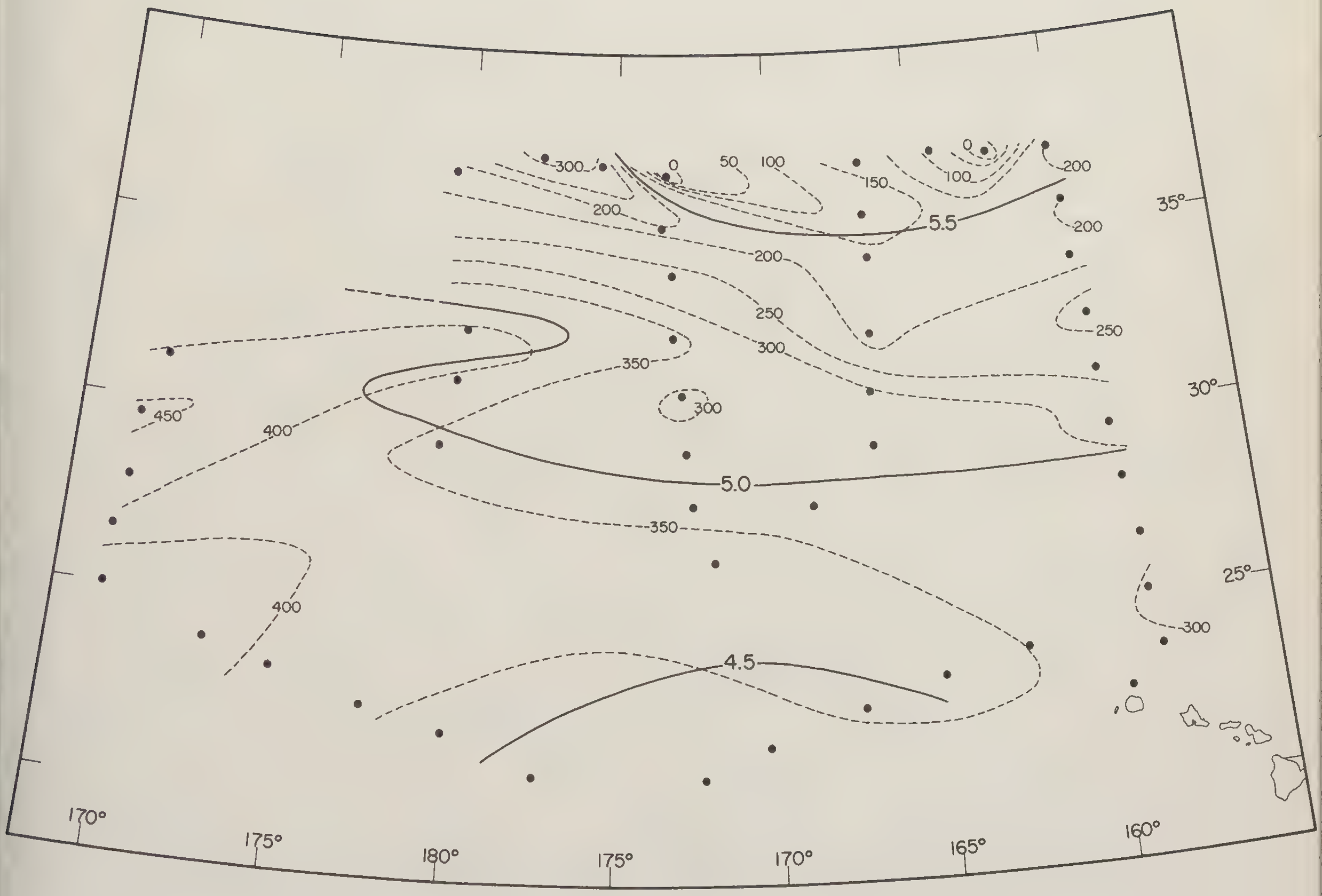

35°
30°
170°
175°
180°
175°
170°
165°
160°
100
150
150
100
50
0
200
150
200
5.0
>
150
200
>
5.0
200
>
5.0
4.5
<
4.5
>
200
200

Figure 92.--Dissolved oxygen in milliliters per liter (solid lines) on the 25.2 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: dissolved oxygen 0.5 ml./l., depth of sigma-t surface 50 m. Dots indicate station positions.



-300-
0
50
100
150
0
100
200
200
200
5.5
35°
200
200
250
250
300
350
30°
450
400
300
5.0
350
25°
400
300
4.5
170°
175°
180°
175°
170°
165°
160°

Figure 93.--Dissolved oxygen in milliliters per liter (solid lines) on the 26.0 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: dissolved oxygen 0.5 ml. /l., depth of sigma-t surface 50 m. Dots indicate station positions.

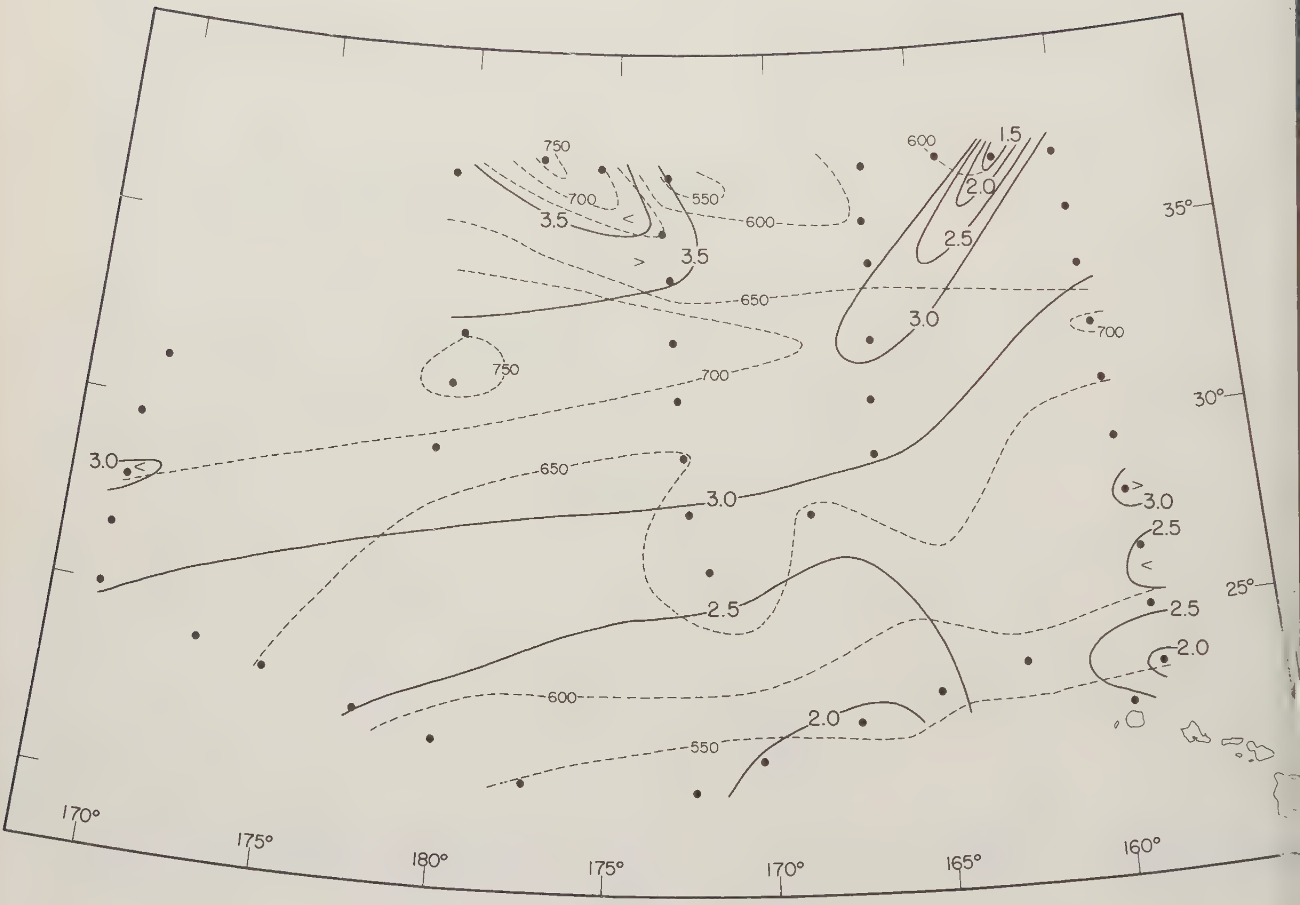
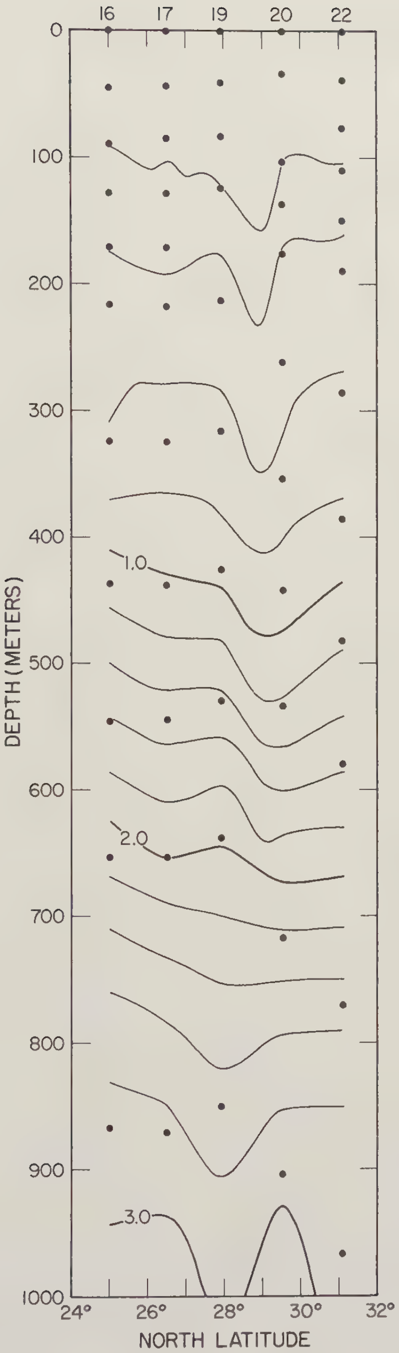

750
700
3.5
550
600
3.5
600
1.5
2.0
2.5
35°
650
3.0
700
750
700
30°
3.0
650
3.0
3.0
2.5
2.5
25°
2.5
2.0
600
2.0
550
170°
175°
180°
175°
170°
165°
160°

Figure 94.--Dissolved oxygen in milliliters per liter (solid lines) on the 26.8 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: dissolved oxygen 0.5 ml./l., depth of sigma-t surface 50 m. Dots indicate station positions.



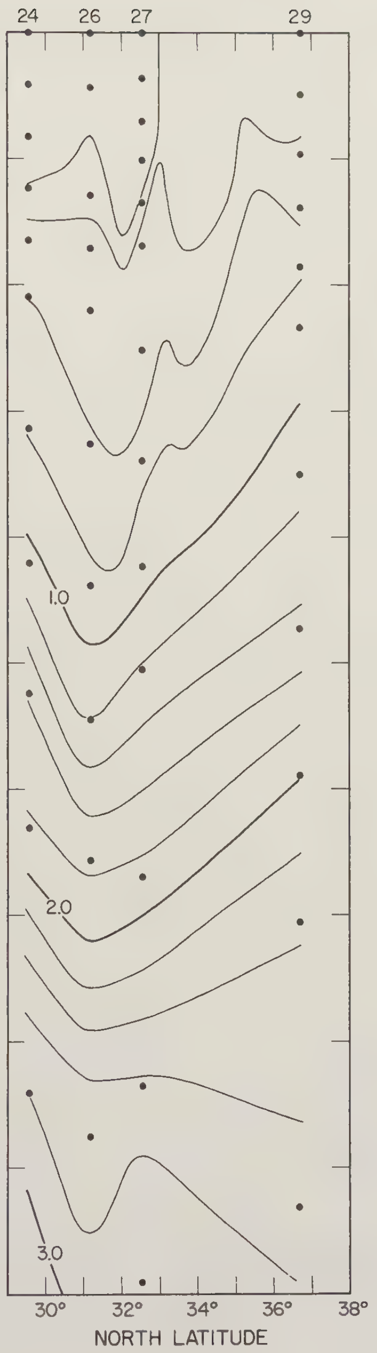
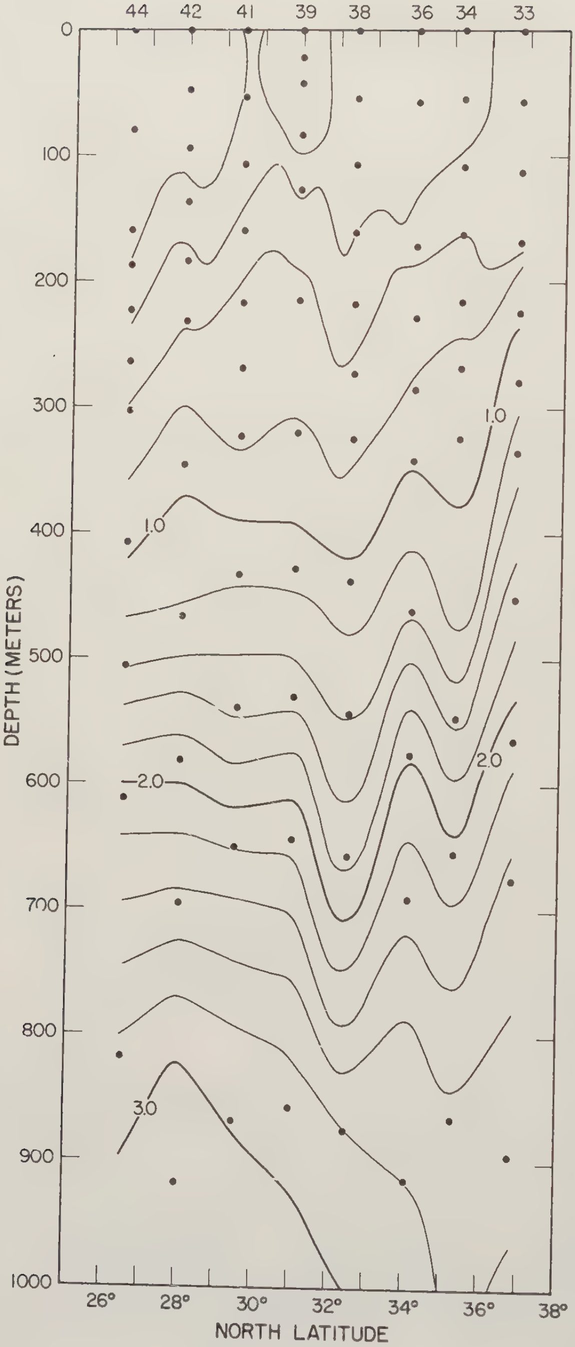


Figure 95.--Vertical section of inorganic phosphate in microgram-atoms per liter along 170°E. longitude, Hugh M. Smith cruise 27, stations 16-22, January-February 1955. Contour interval 0.2 µg at./l.

Figure 96.--Same along the 180th meridian, stations 24-29.



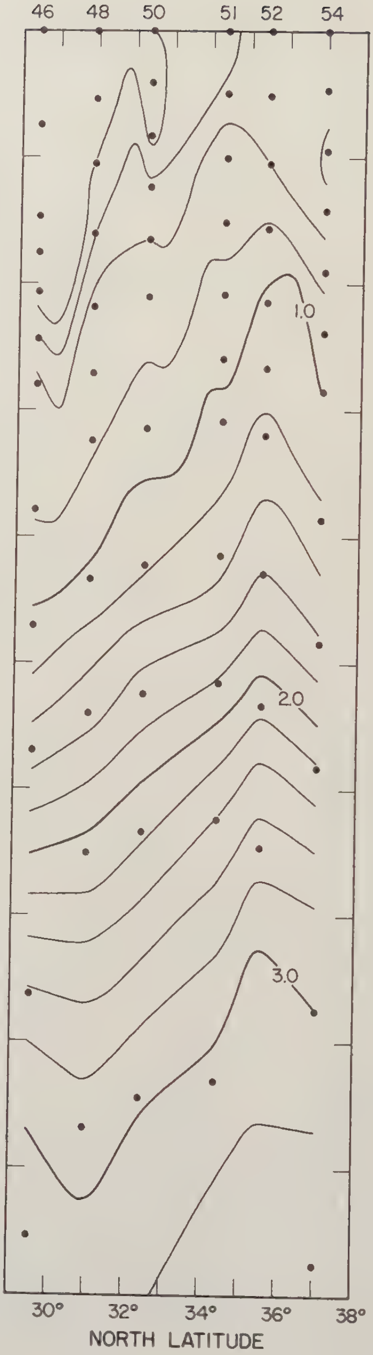


Figure 97.--Vertical section of inorganic phosphate in microgram-atoms per liter along 172°W. longitude, Hugh M. Smith cruise 27, stations 33-44, January-February 1955. Contour interval 0.2 μg at. /l.

Figure 98.--Same along 167°W. longitude, stations 46-54.

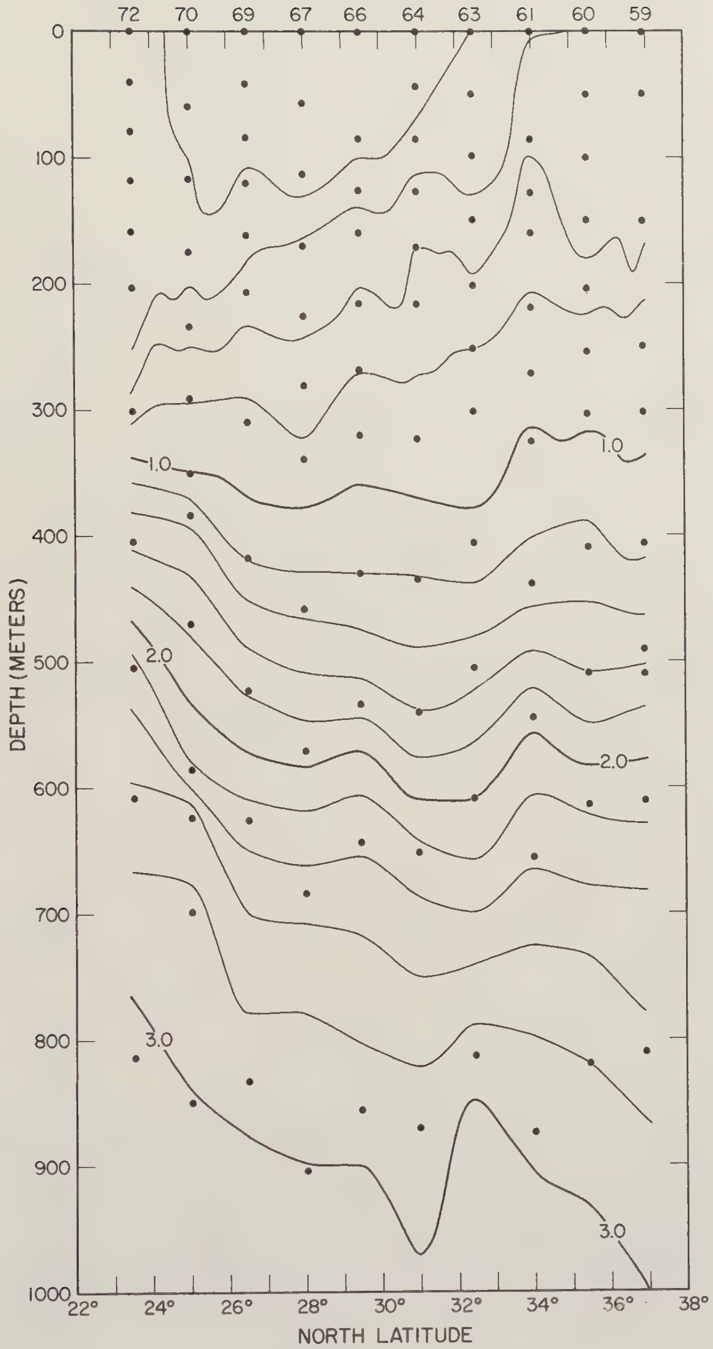


Figure 99.--Vertical section of inorganic phosphate in microgram-atoms per liter along 159°W. longitude, *Hugh M. Smith* cruise 27, stations 59-72, January-February 1955. Contour interval 0.2 µg at./l.

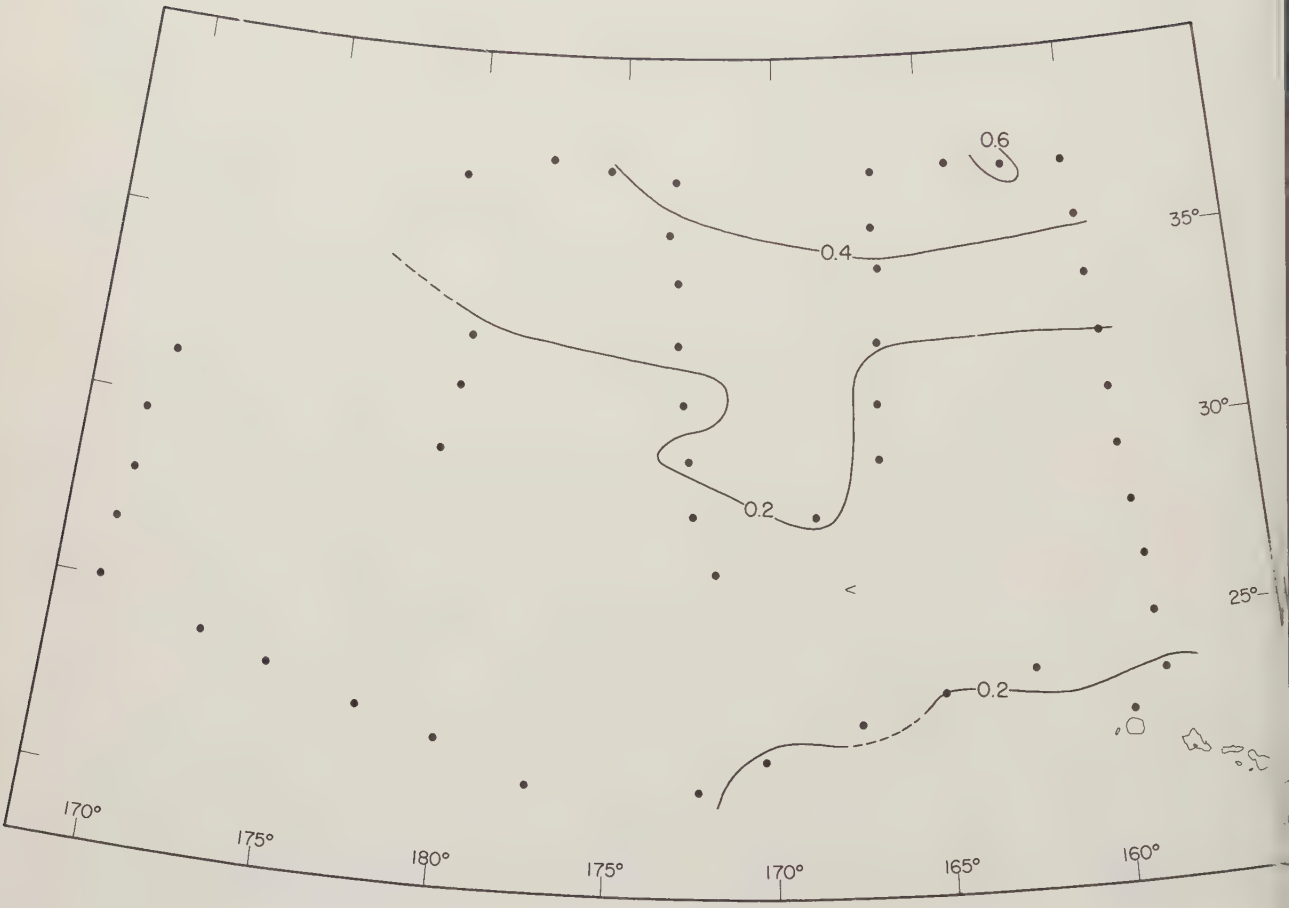

0.6
0.4
0.2
0.2
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 100.--Surface inorganic phosphate in microgram-atoms per liter; Hugh M. Smith cruise 27, January-February 1955. Contour interval 0.2 µg at./l. Dots indicate observed values.

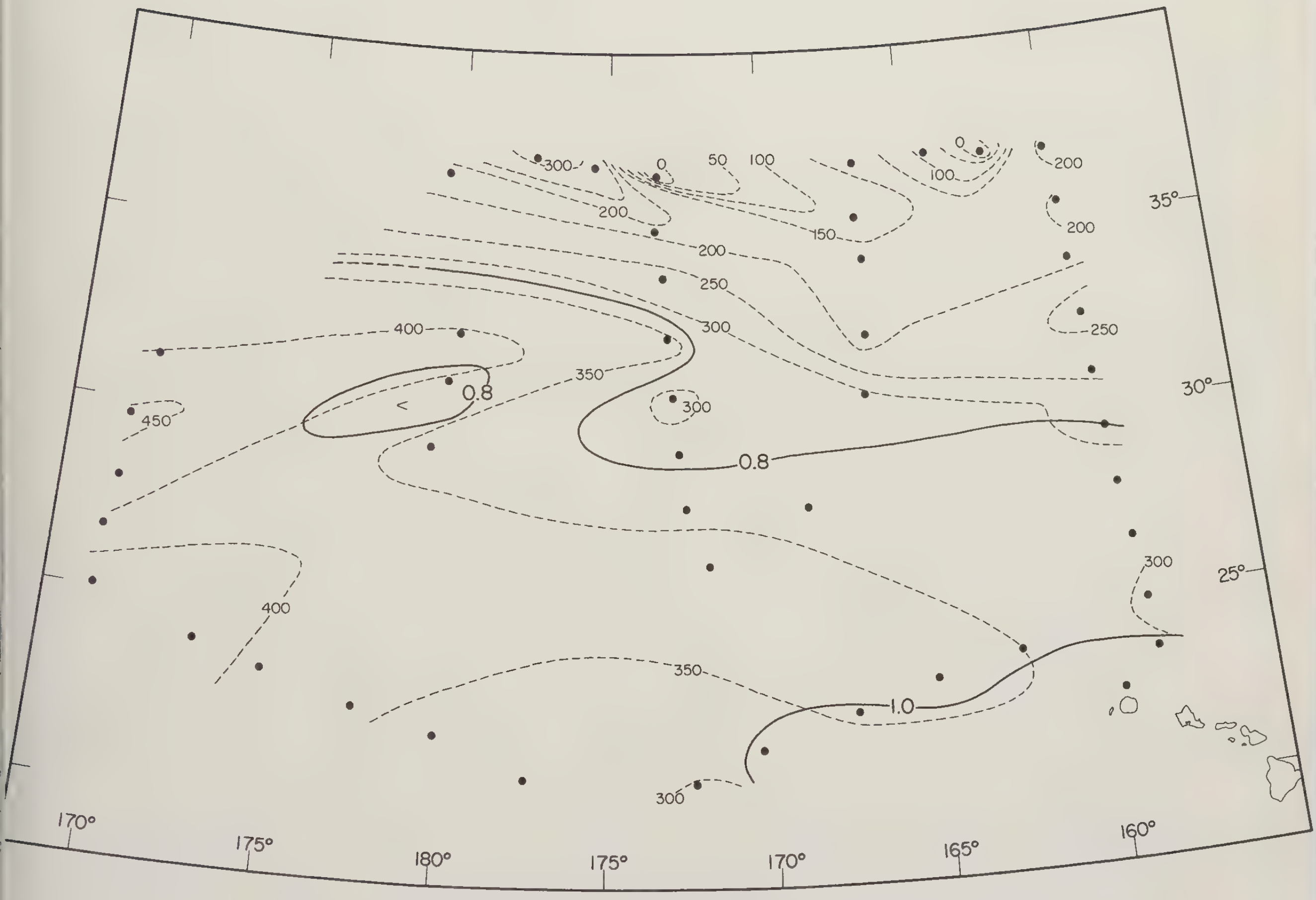

300
0
50
100
0
100
200
200
150
200
200
250
250
300
400
250
350
0.8
<
450
30°
300
0.8
35°
300
25°
400
350
1.0
300
170°
175°
180°
175°
170°
165°
160°

Figure 101.--Inorganic phosphate in microgram-atoms per liter (solid lines) on the 26.0 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: inorganic phosphate 0.2 µg at. /l., depth of sigma-t surface 50 m. Dots indicate station positions.

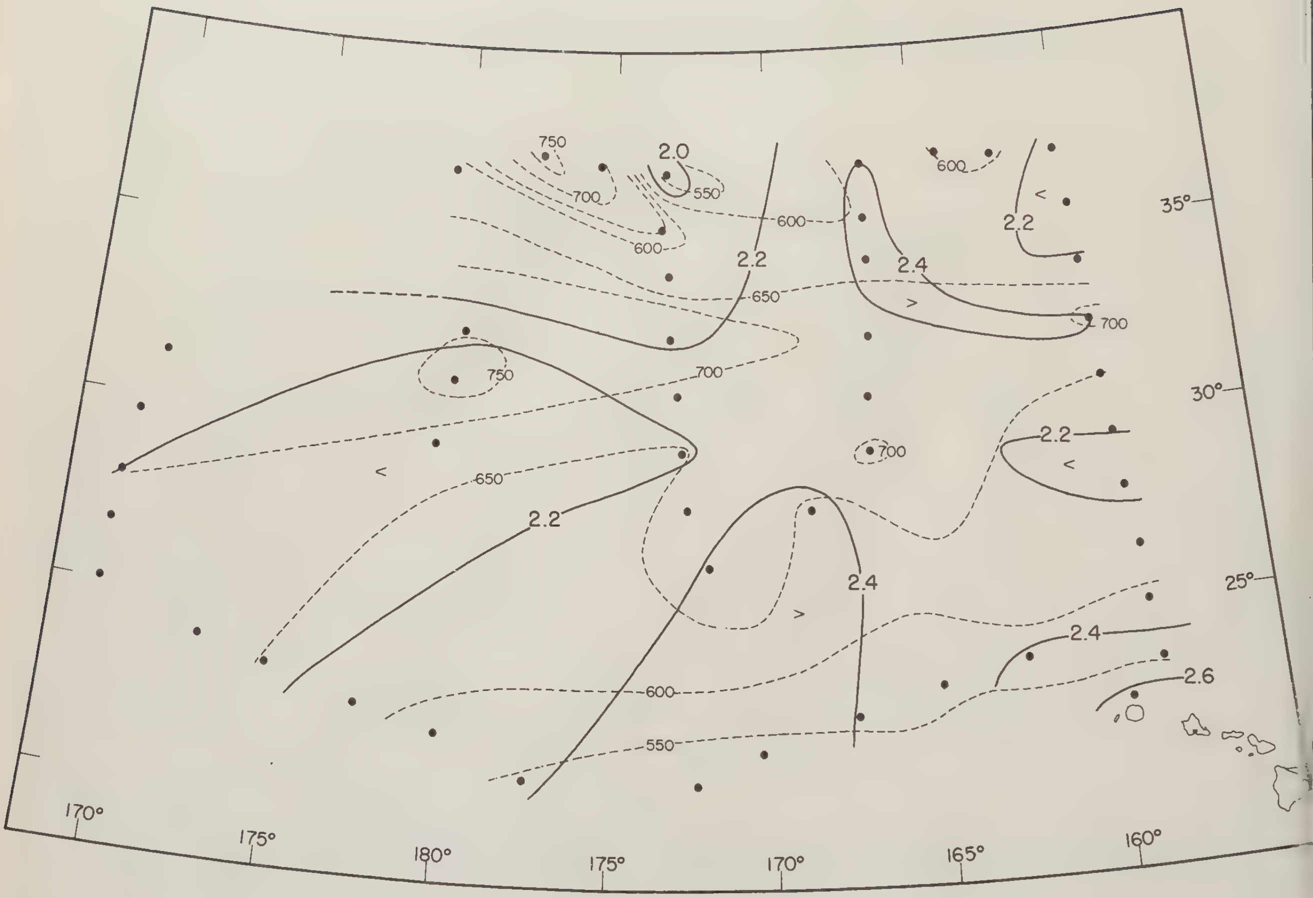

750
2.0
700
550
600
600
2.2
650
600
2.2
2.4
700
750
700
700
650
2.2
2.2
2.4
2.4
600
550
2.6
35°
30°
25°
170°
175°
180°
175°
170°
165°
160°

Figure 102.--Inorganic phosphate in microgram-atoms per liter (solid lines) on the 26.8 sigma-t surface (depth in meters, dotted lines); Hugh M. Smith cruise 27, January-February 1955. Contour intervals: inorganic phosphate 0.2 µg at. /l., depth of sigma-t surface 50 m. Dots indicate station positions.

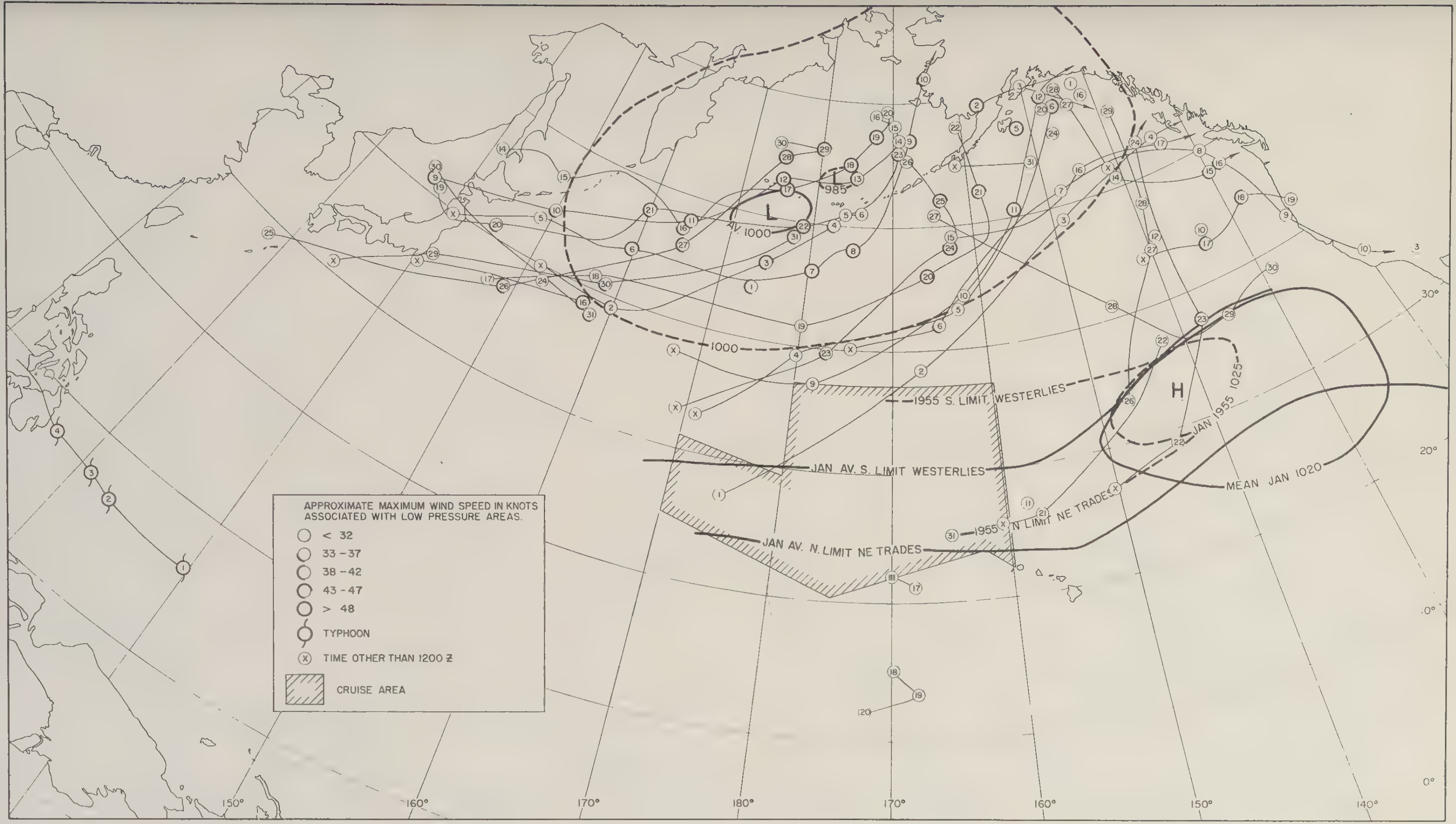

APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS.
< 32
33 - 37
38 - 42
43 - 47
> 48
TYPHOON
TIME OTHER THAN 1200 Z
CRUISE AREA
L
985
AV. 1000
1000
H
1025
JAN 1955
MEAN JAN 1020
1955 S. LIMIT WESTERLIES
JAN AV. S. LIMIT WESTERLIES
1955 N LIMIT NE TRADES
JAN AV. N. LIMIT NE TRADES
30°
20°
0°
150°
160°
170°
180°
170°
160°
150°
140°

Figure 103.--Normal (heavy solid lines) and mean January 1955 (broken lines) position of the Aleutian Low and Eastern North Pacific High; normal and 1954 mean monthly limits of northeast trades and westerlies; tracks of centers of low pressure areas, showing daily positions.

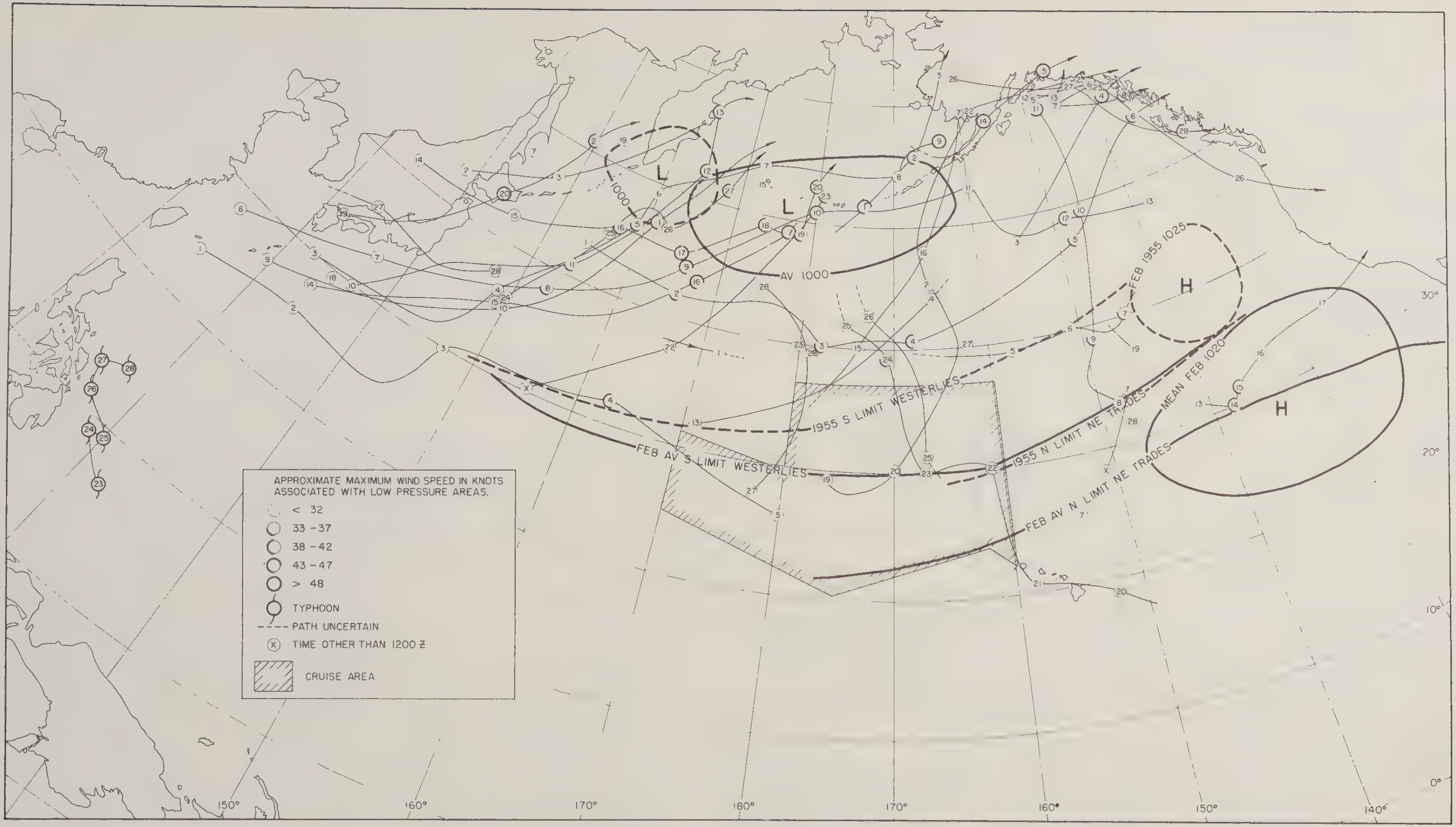

APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS.
< 32
33 - 37
38 - 42
43 - 47
> 48
TYPHOON
PATH UNCERTAIN
TIME OTHER THAN 1200 Z
CRUISE AREA
L
L
H
H
AV 1000
1000
FEB 1955 1025
MEAN FEB 1020
1955 S LIMIT WESTERLIES
FEB AV S LIMIT WESTERLIES
1955 N LIMIT NE TRADES
FEB AV N LIMIT NE TRADES
150°
160°
170°
180°
170°
160°
150°
140°
30°
20°
10°
0°

Figure 104. --Normal (heavy solid lines) and mean February 1955 (broken lines) position of the Aleutian Low and Eastern North Pacific High; normal and 1954 mean monthly limits of northeast trades and westerlies; tracks of centers of low pressure areas, showing daily positions.

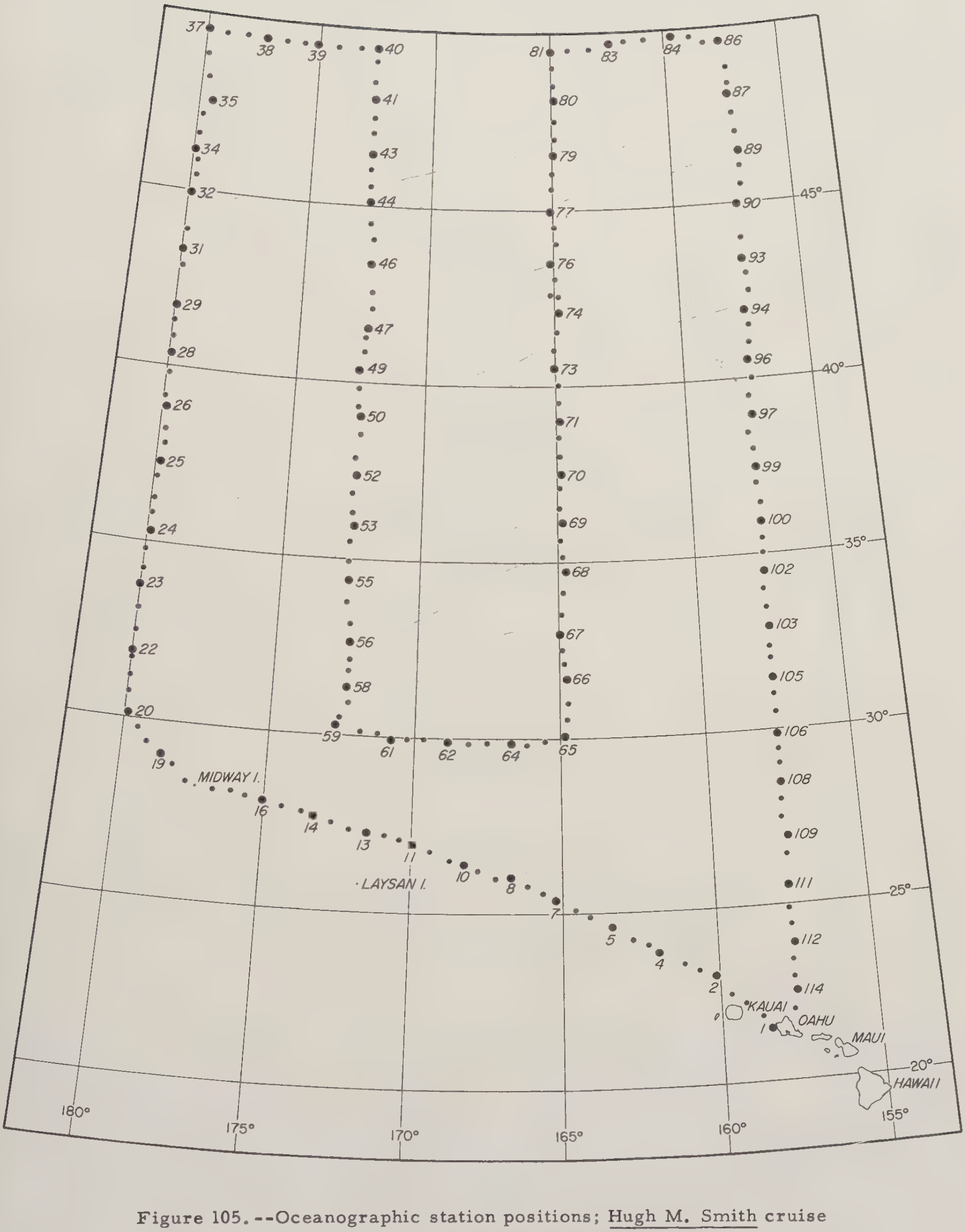

37
38
39
40
81
83
84
86
35
41
80
87
34
43
79
89
32
44
77
90
45°
31
46
76
93
29
47
74
94
28
49
73
96
40°
26
50
71
97
25
52
70
99
24
53
69
100
35°
23
55
68
102
22
56
67
103
58
66
105
20
59
61
62
64
65
106
30°
19
MIDWAY I.
108
16
14
13
11
109
10
8
LAYSAN I.
111
7
25°
5
112
4
2
114
KAUAI
0
1
OAHU
MAUI
20°
HAWAII
180°
175°
170°
165°
160°
155°

Figure 105.--Oceanographic station positions; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Larged numbered dots indicate oceanographic stations. Small dots indicate positions of BT lowerings between stations.

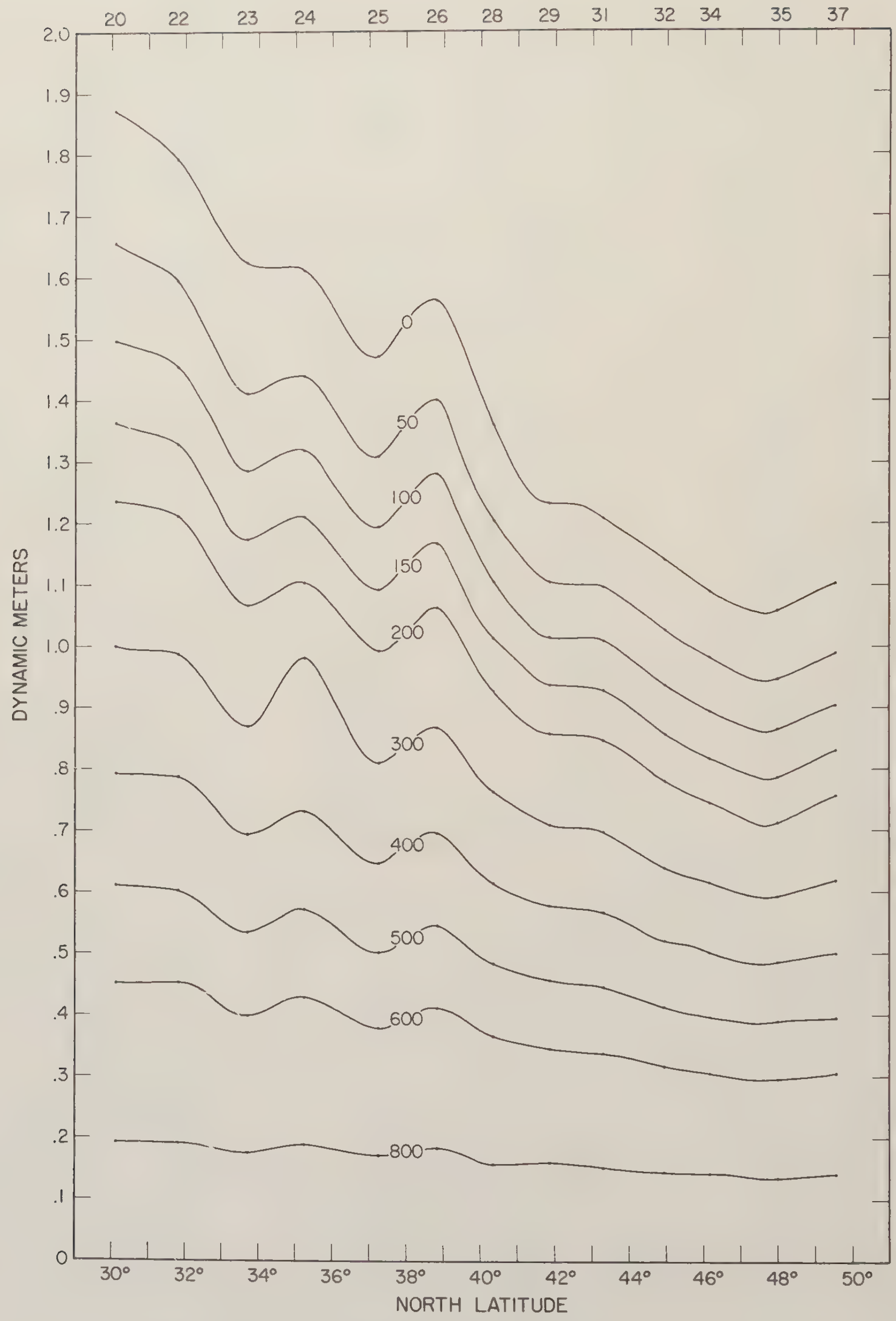


Figure 106.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface, neglecting pressure terms in the specific volume anomaly, along the 180th meridian; Hugh M. Smith cruise 30 (NORPAC), stations 20-37, July-August 1955. Points represent computed values.

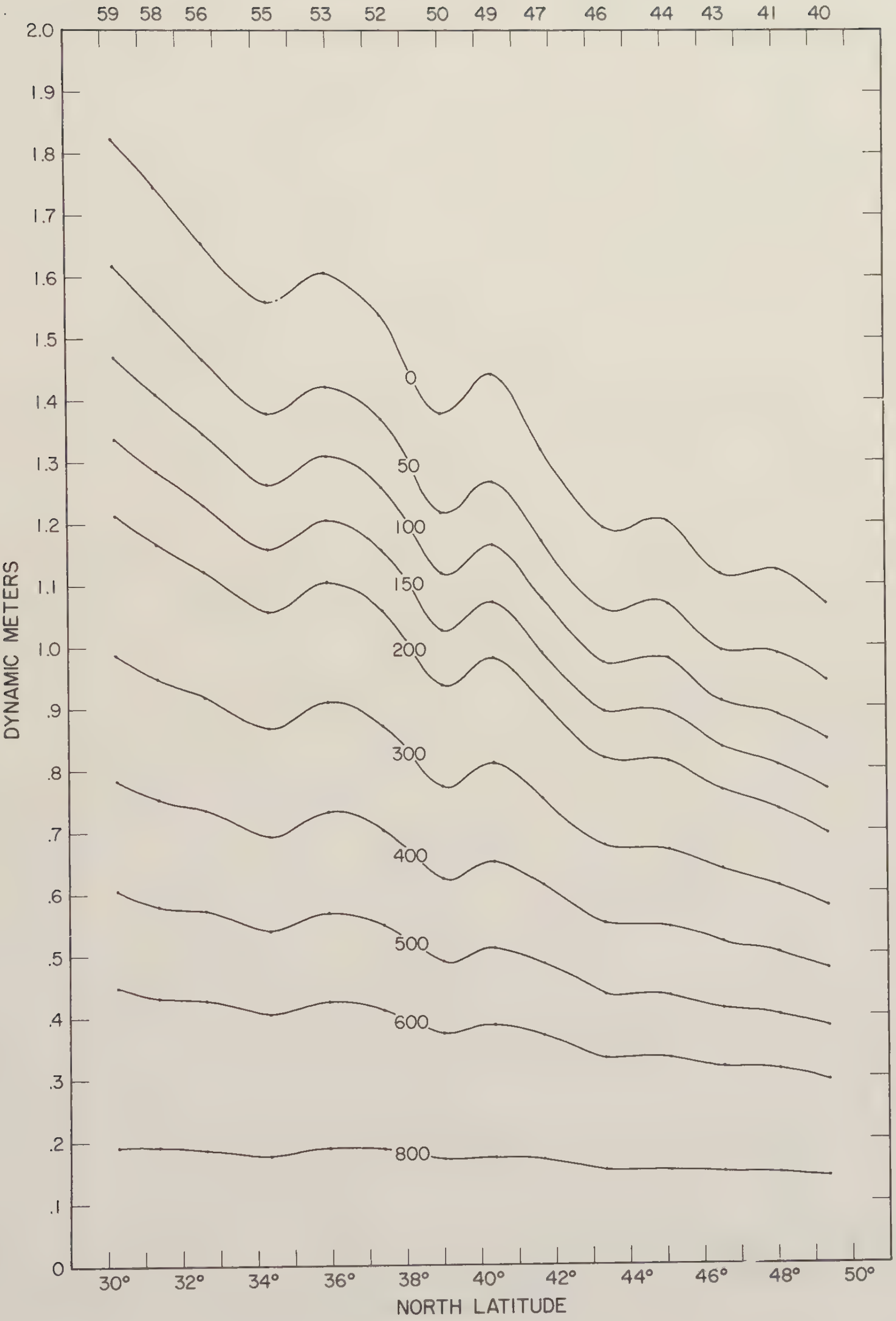


Figure 107.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface, neglecting pressure terms in the specific volume anomaly, along 172°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 40-59, July-August 1955. Points represent computed values.

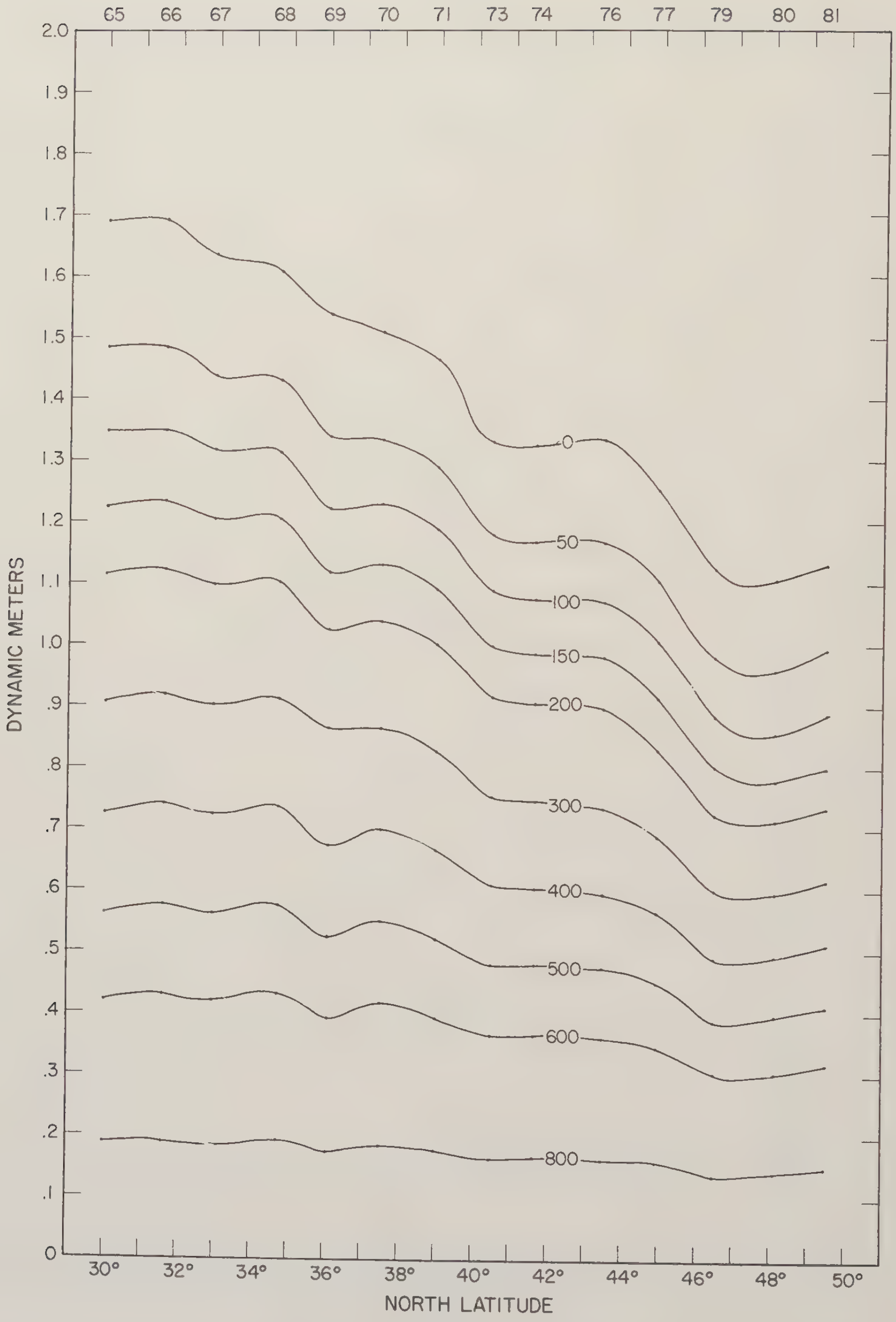


Figure 108.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface, neglecting pressure terms in the specific volume anomaly, along 165°W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 65-81, July-August 1955. Points represent computed values.

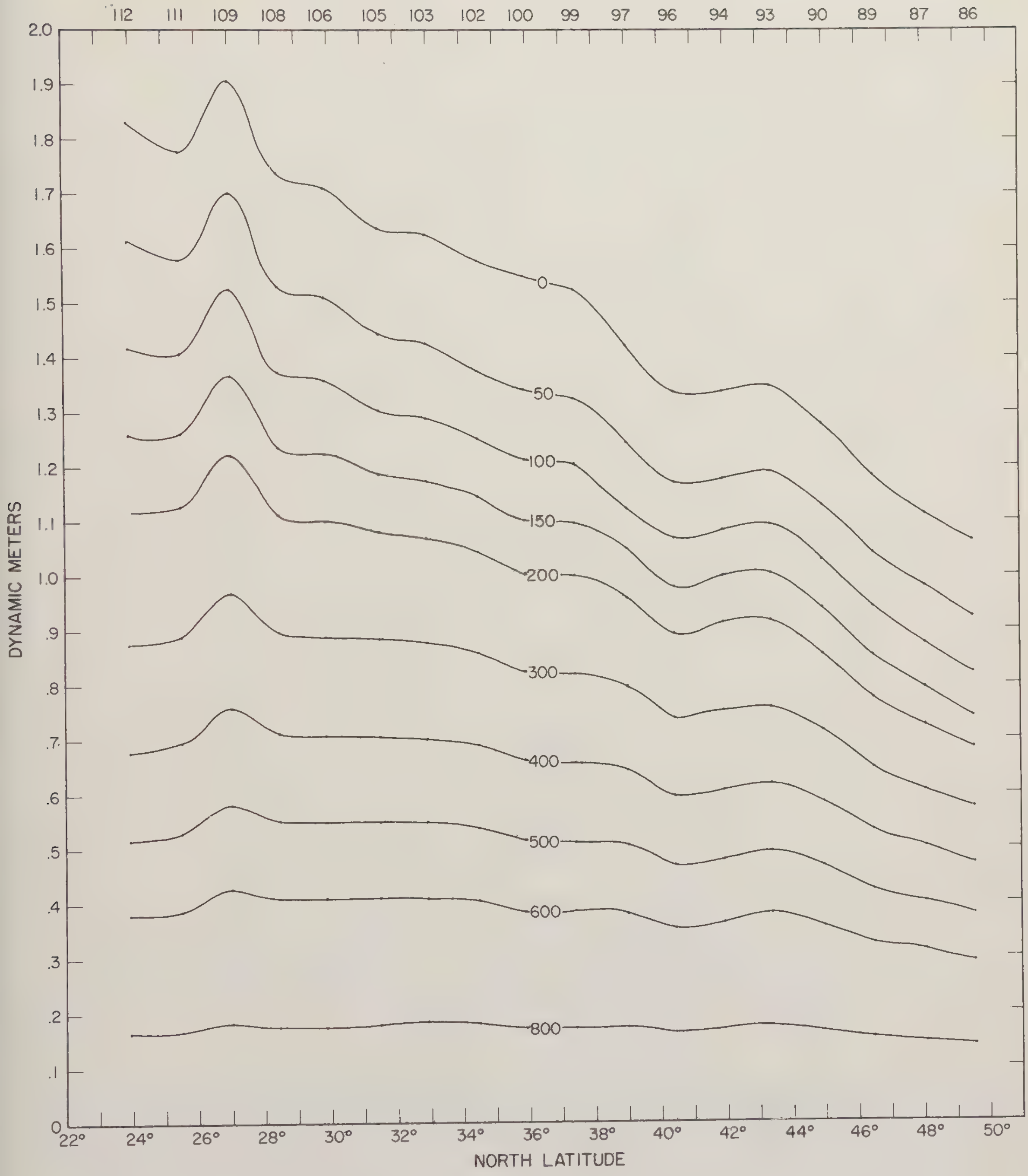


Figure 109.--Smoothed geopotential anomaly of the isobaric surfaces in dynamic meters relative to the 1,000-db. surface, neglecting pressure terms in the specific volume anomaly, along 157°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 86-112, July-August 1955. Points represent computed values.

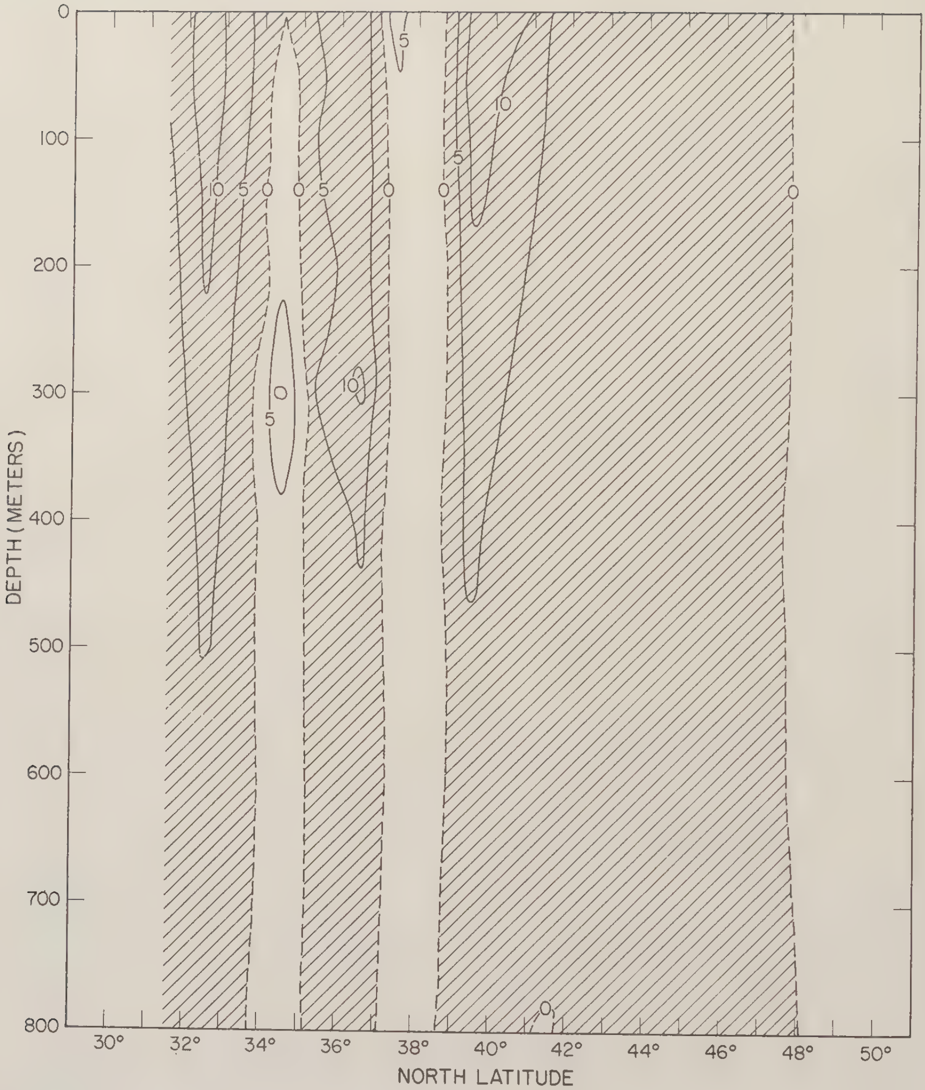


Figure 110.--Zonal components of the geostrophic currents in centimeters per second across the 180th meridian; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

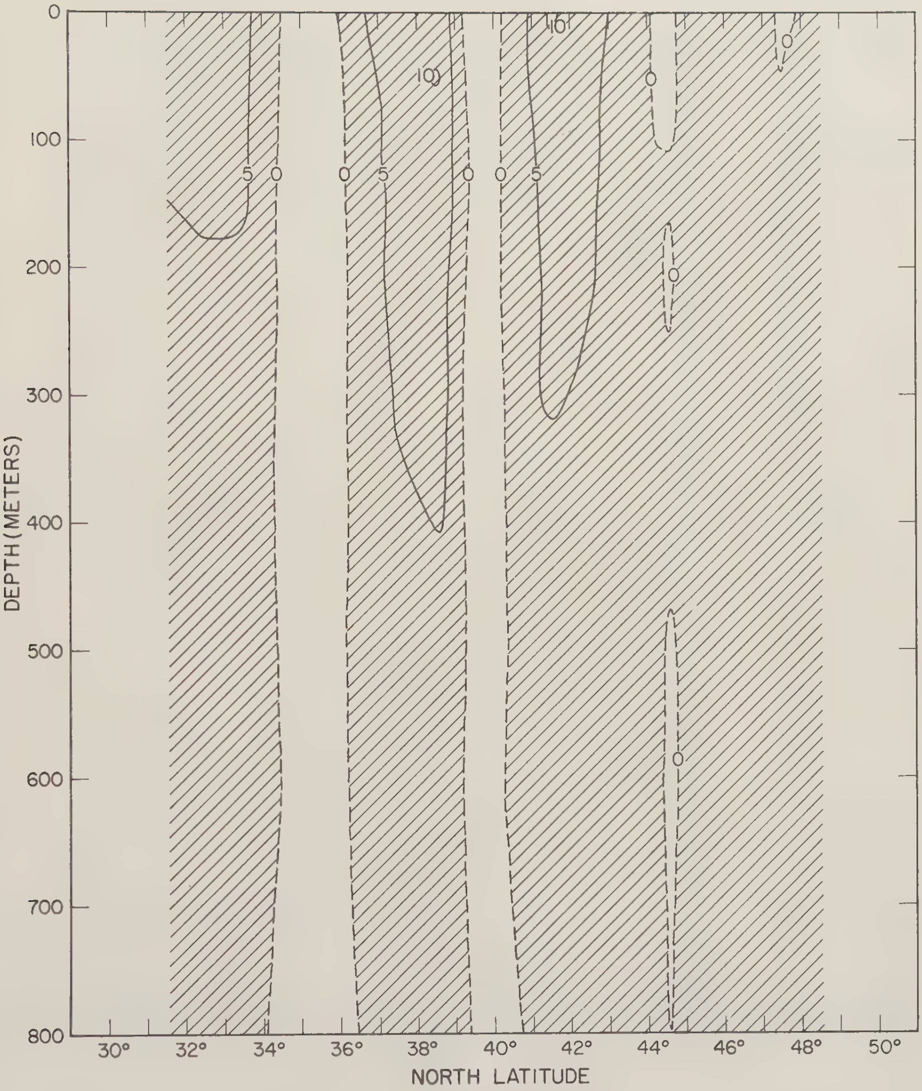


Figure 111.--Zonal components of the geostrophic currents in centimeters per second across 172° W. longitude; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

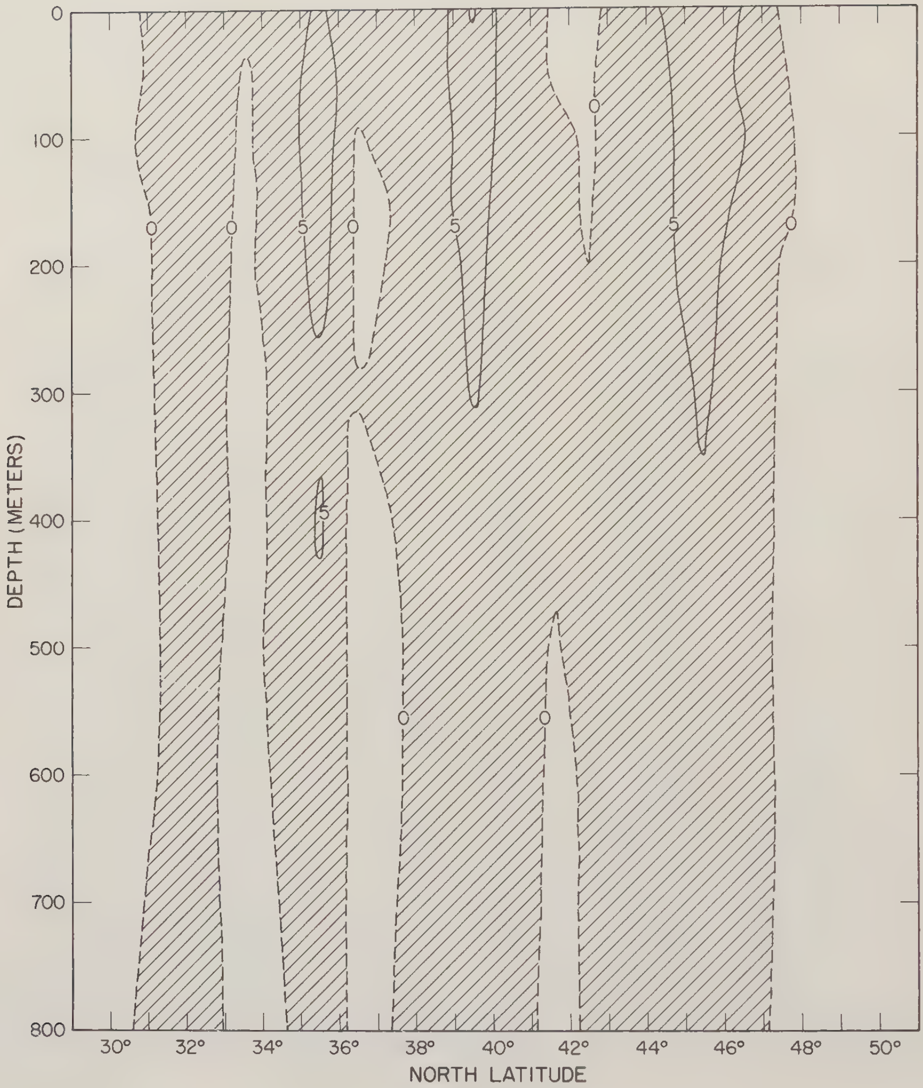


Figure 112.--Zonal components of the geostrophic currents in centimeters per second across 165°W. longitude; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Hatched areas indicate easterly flow. Contour interval 5 cm. /sec.

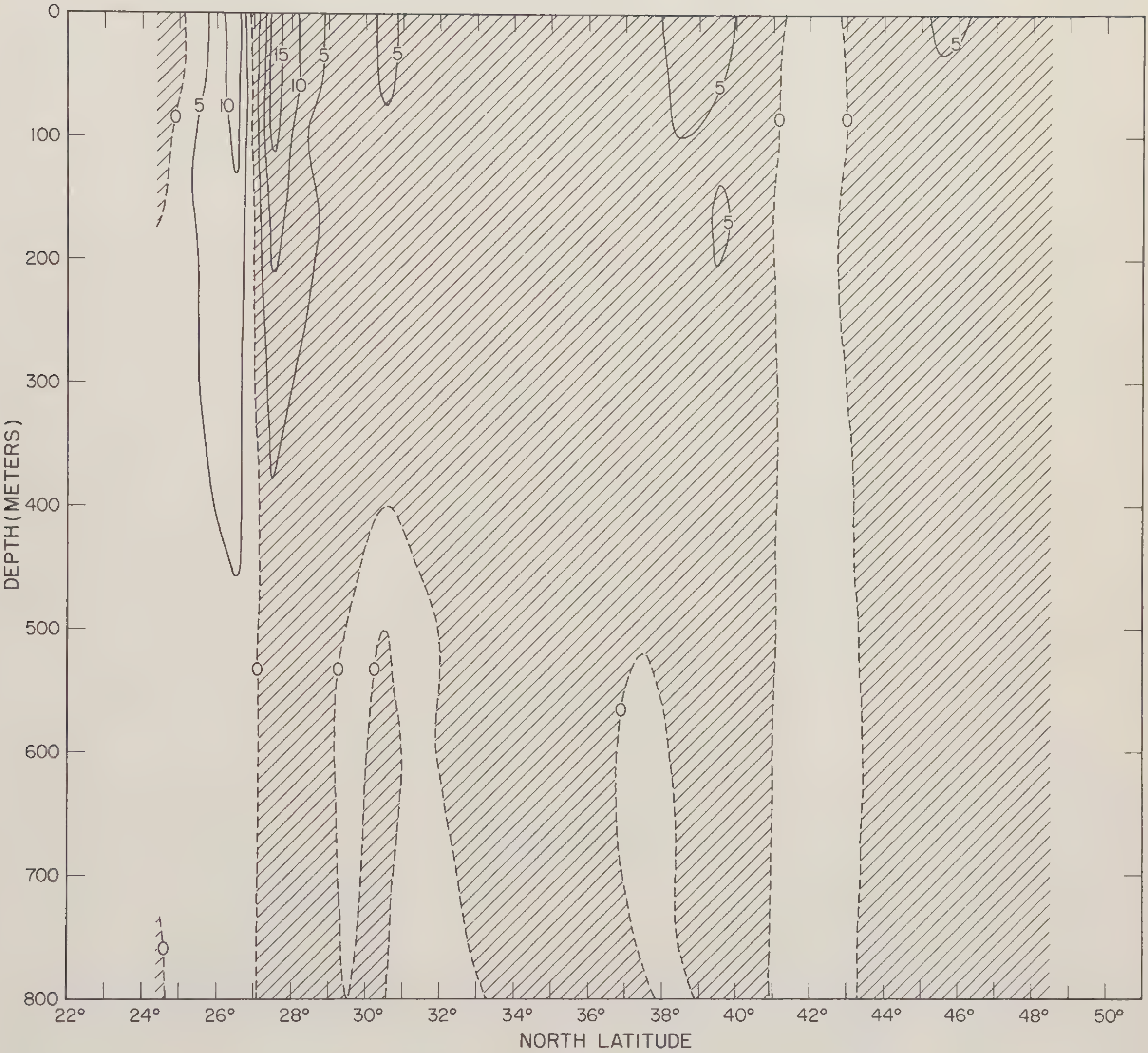


Figure 113.--Zonal components of the geostrophic currents in centimeters per second across 157°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Hatched areas indicate easterly flow. Contour interval 5 cm./sec.

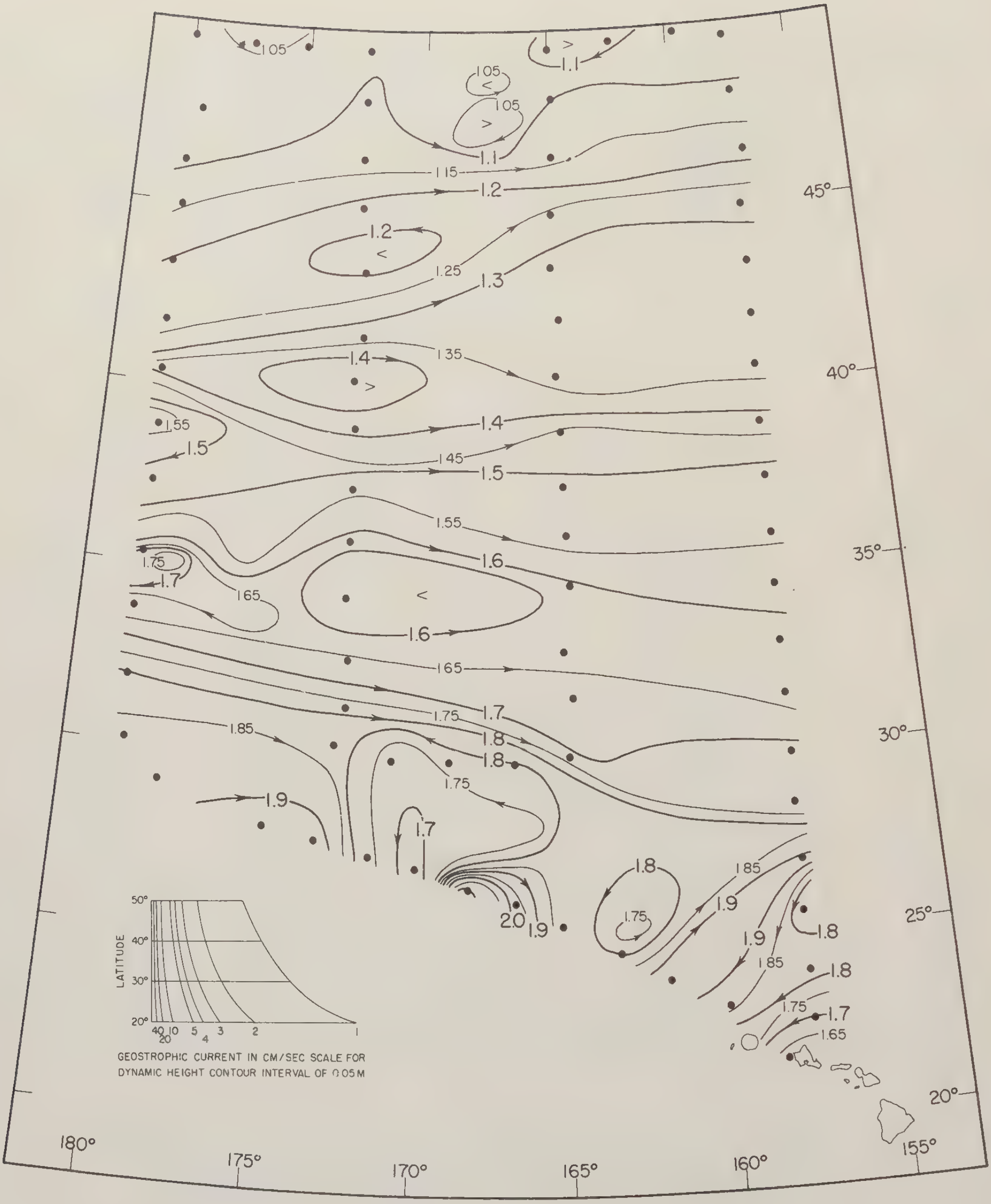

1.05
1.1
1.05
1.05
1.1
1.15
1.2
1.2
1.25
1.3
1.35
1.4
1.55
1.5
1.4
1.45
1.5
1.55
1.6
1.75
1.7
1.65
1.6
1.65
1.75
1.7
1.8
1.8
1.85
1.9
1.75
1.7
2.0
1.9
1.8
1.75
1.85
1.9
1.9
1.85
1.8
1.8
1.75
1.7
1.65
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°
50°
40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 114. --Anomaly of the geopotential topography of the sea surface in dynamic meters relative to the 1,000-db. surface; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

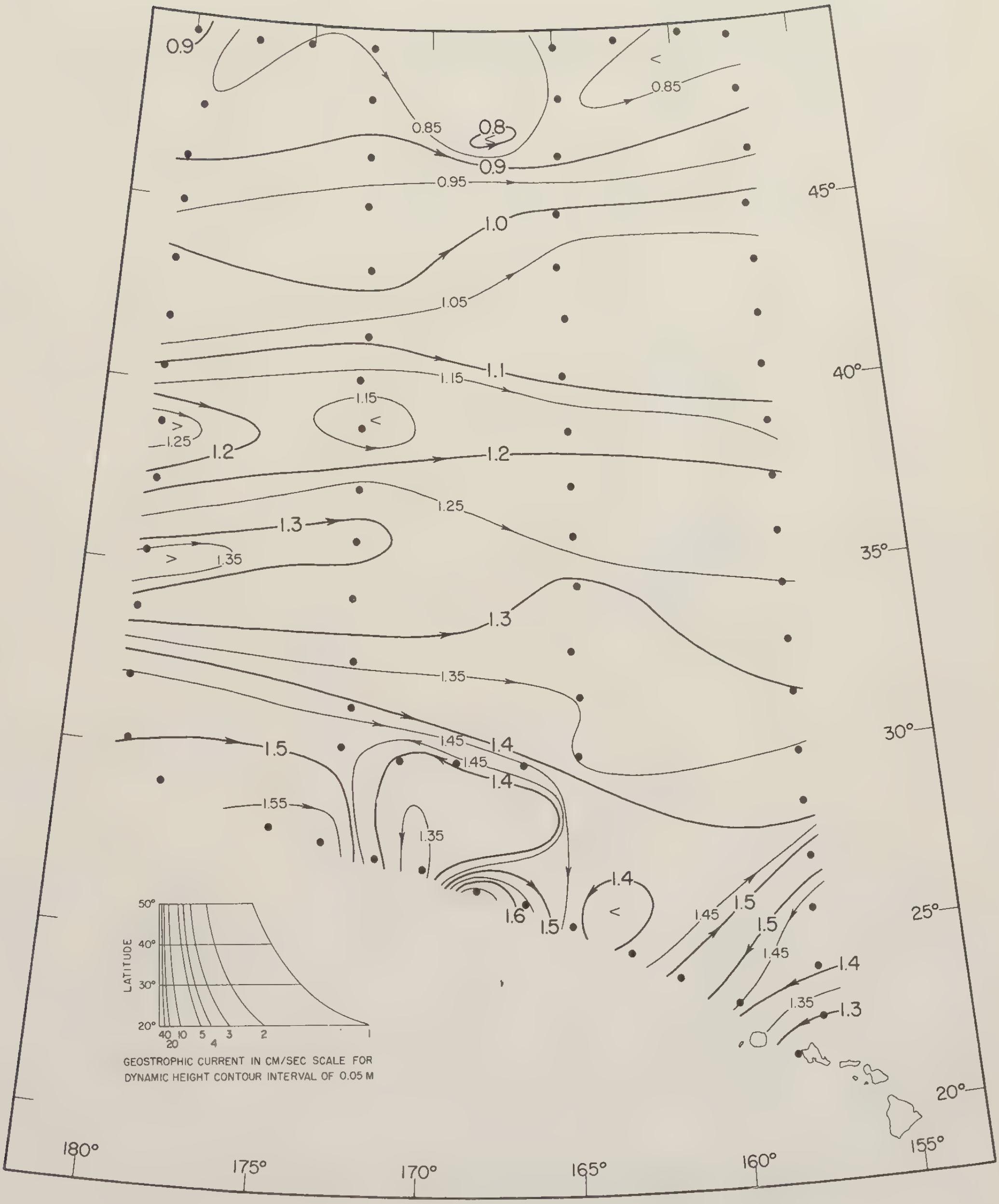

0.9
0.85
0.8
0.9
0.95
1.0
1.05
1.1
1.15
1.15
1.25
1.2
1.2
1.25
1.3
1.35
1.3
1.35
1.45
1.4
1.45
1.4
1.5
1.55
1.35
1.6
1.5
1.4
1.45
1.5
1.5
1.45
1.4
1.35
1.3
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°
50°
40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 115.--Anomaly of the geopotential topography of the 100-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

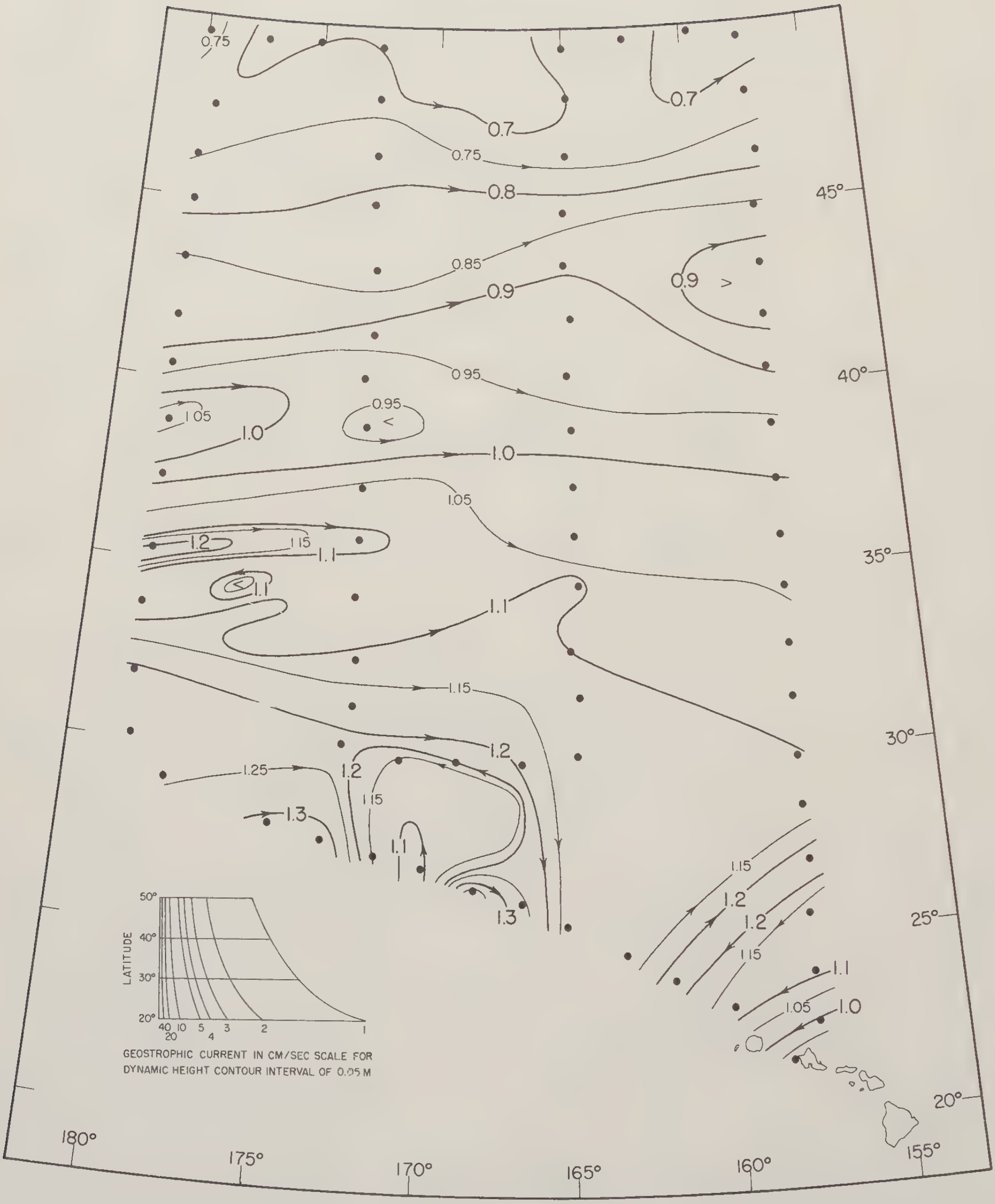

0.75
0.7
0.7
0.75
0.8
0.85
0.9
0.9
45°
40°
0.95
0.95
1.05
1.0
1.0
1.05
1.2
1.15
1.1
1.1
1.1
35°
1.15
30°
1.25
1.2
1.2
1.15
1.3
1.1
1.3
25°
1.15
1.2
1.2
1.15
1.1
1.05
1.0
20°
180°
175°
170°
165°
160°
155°
50°
40°
30°
20°
LATITUDE
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 116.--Anomaly of the geopotential topography of the 200-db. surface in dynamic meters relative to the 1000-db. surface; *Hugh M. Smith* cruise 30 (NORPAC), July-August 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

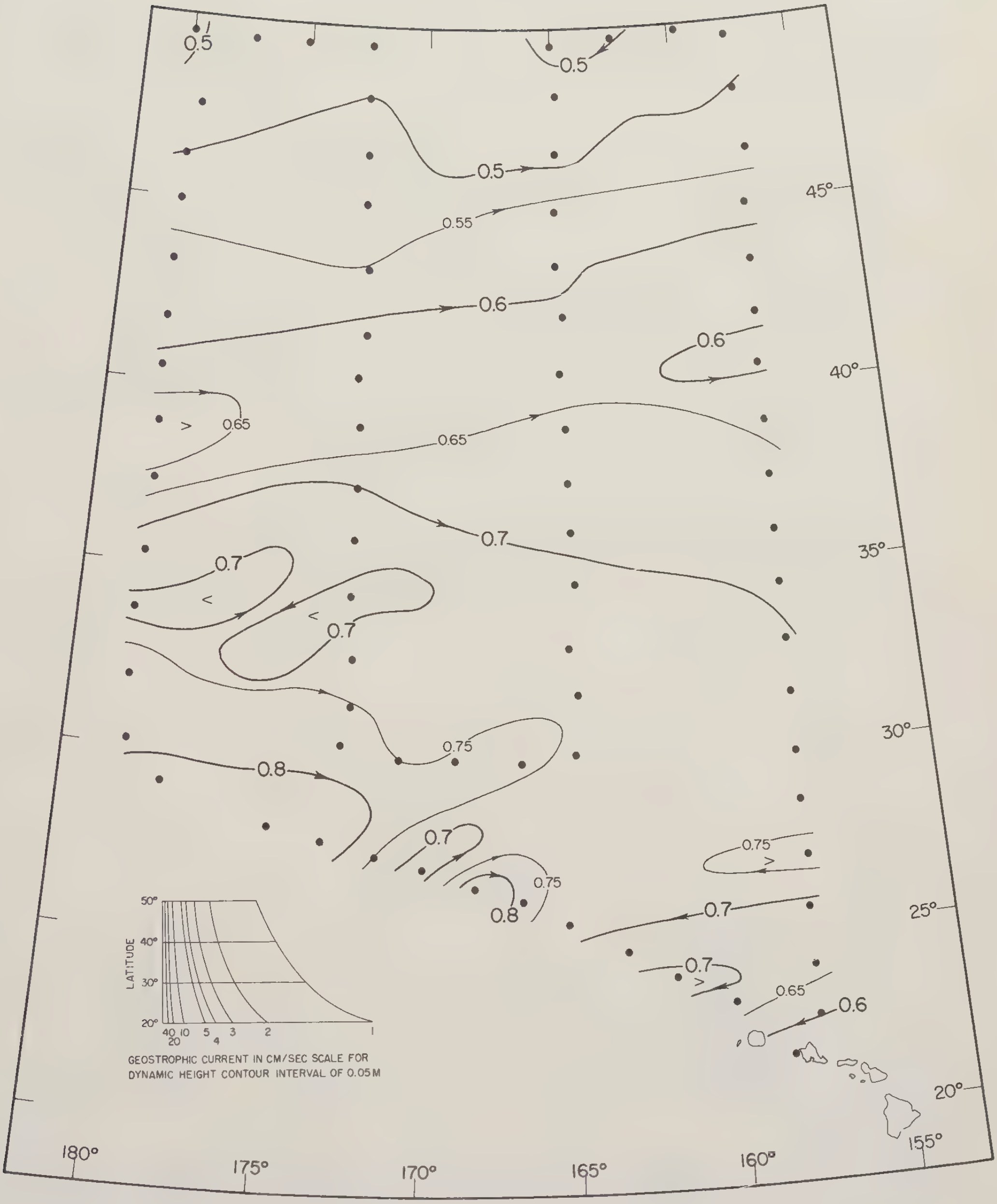

0.5
0.5
0.5
0.55
0.6
0.6
0.65
0.65
0.7
0.7
0.7
0.75
0.8
0.7
0.75
0.8
0.75
0.7
0.7
0.65
0.6
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°
LATITUDE
50°
40°
30°
20°
40 10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.05 M

Figure 117.--Anomaly of the geopotential topography of the 400-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.05 m.

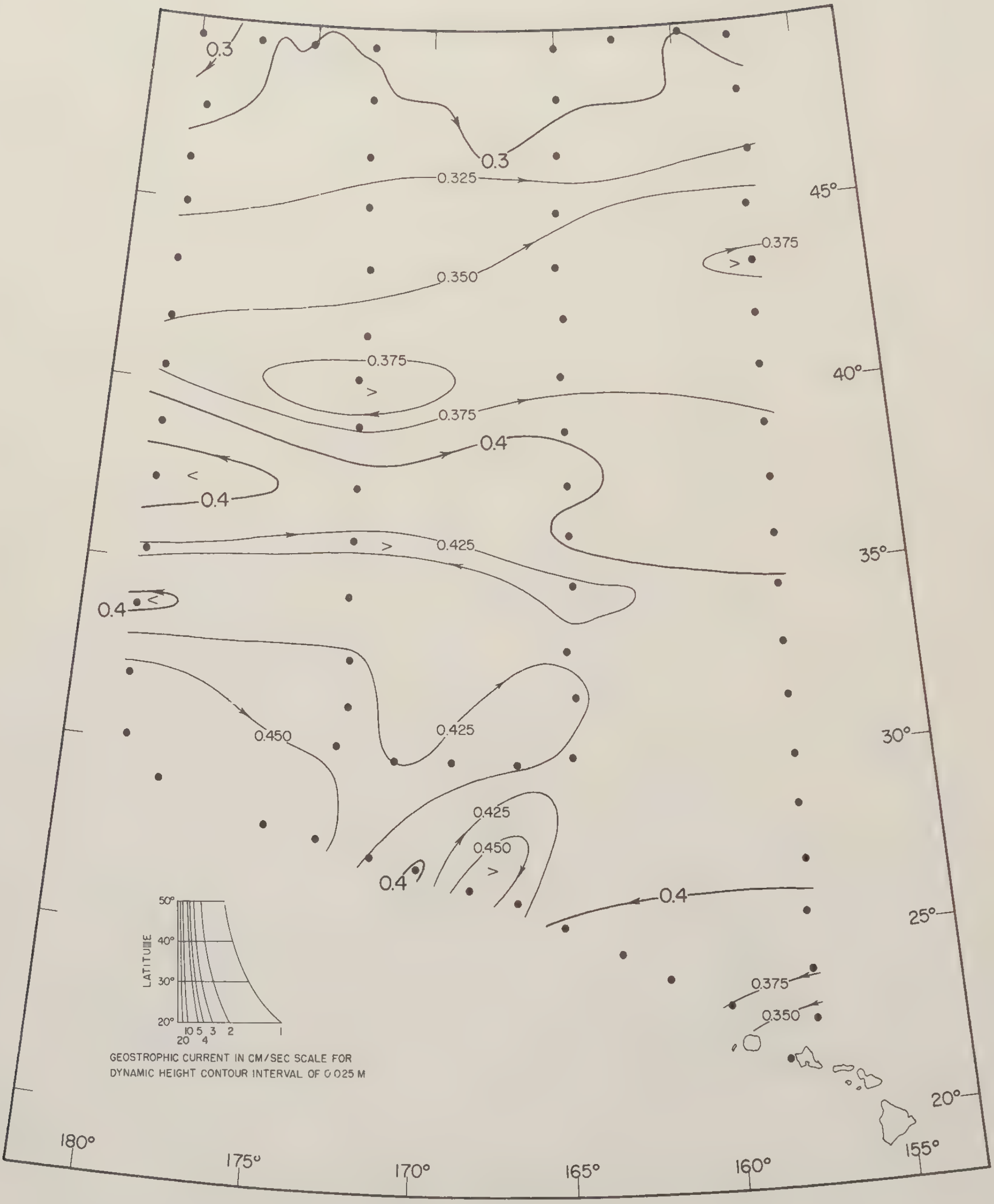

0.3
0.3
0.325
45°
0.375
0.350
0.375
40°
0.375
0.4
0.4
0.425
35°
0.4
0.450
0.425
30°
0.425
0.450
0.4
0.4
25°
50°
40°
LATITUDE
30°
20°
10 5 3 2 1
20 4
GEOSTROPHIC CURRENT IN CM/SEC SCALE FOR
DYNAMIC HEIGHT CONTOUR INTERVAL OF 0.025 M
0.375
0.350
20°
180°
175°
170°
165°
160°
155°

Figure 118.--Anomaly of the geopotential topography of the 600-db. surface in dynamic meters relative to the 1000-db. surface; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Points indicate computed values. Arrows indicate direction of flow. Contour interval 0.025 m.

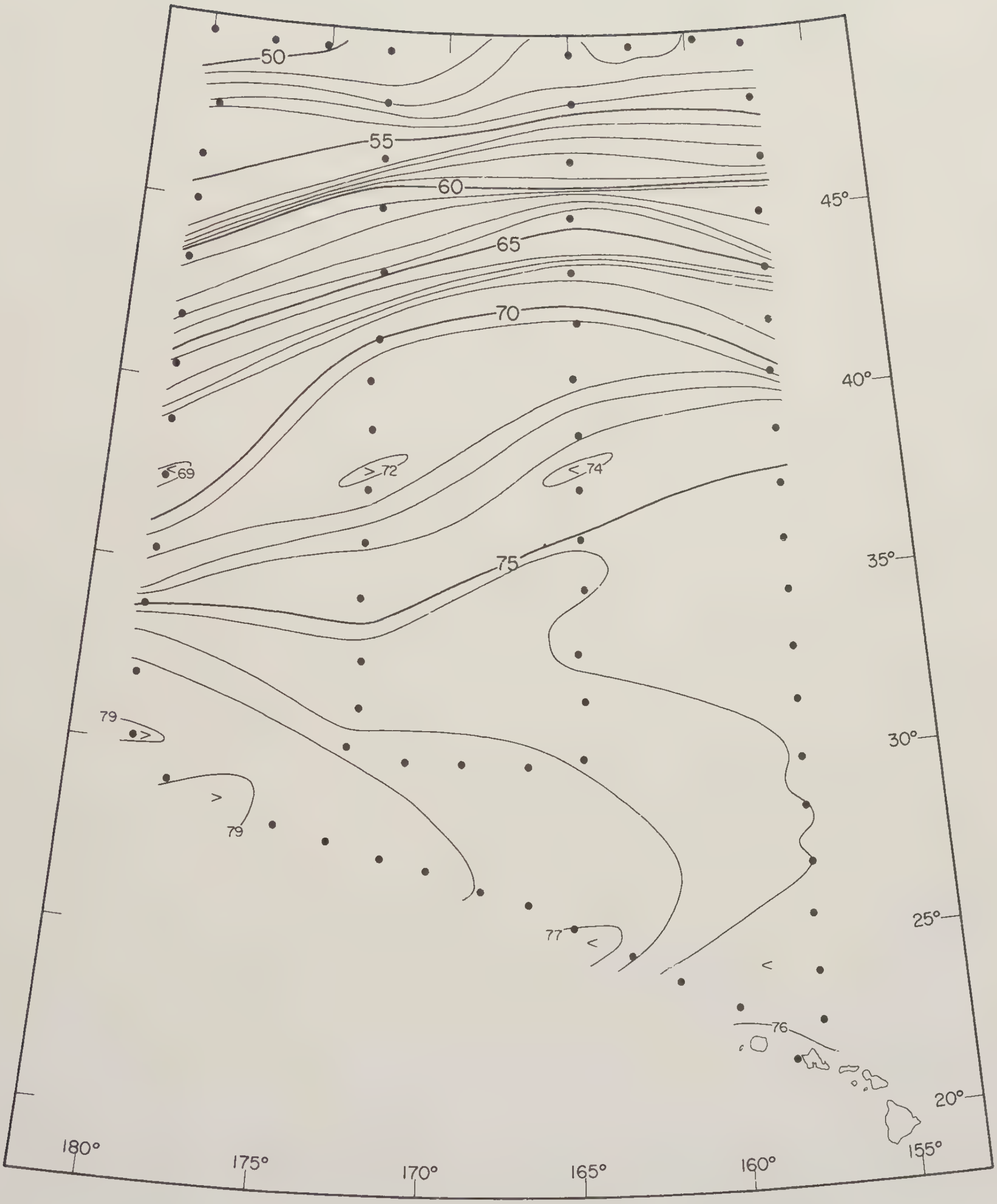

50
55
60
65
70
75
69
72
74
79
79
77
76
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°

Figure 119.--Surface (bucket) temperature in degrees Fahrenheit; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour interval 1°F.

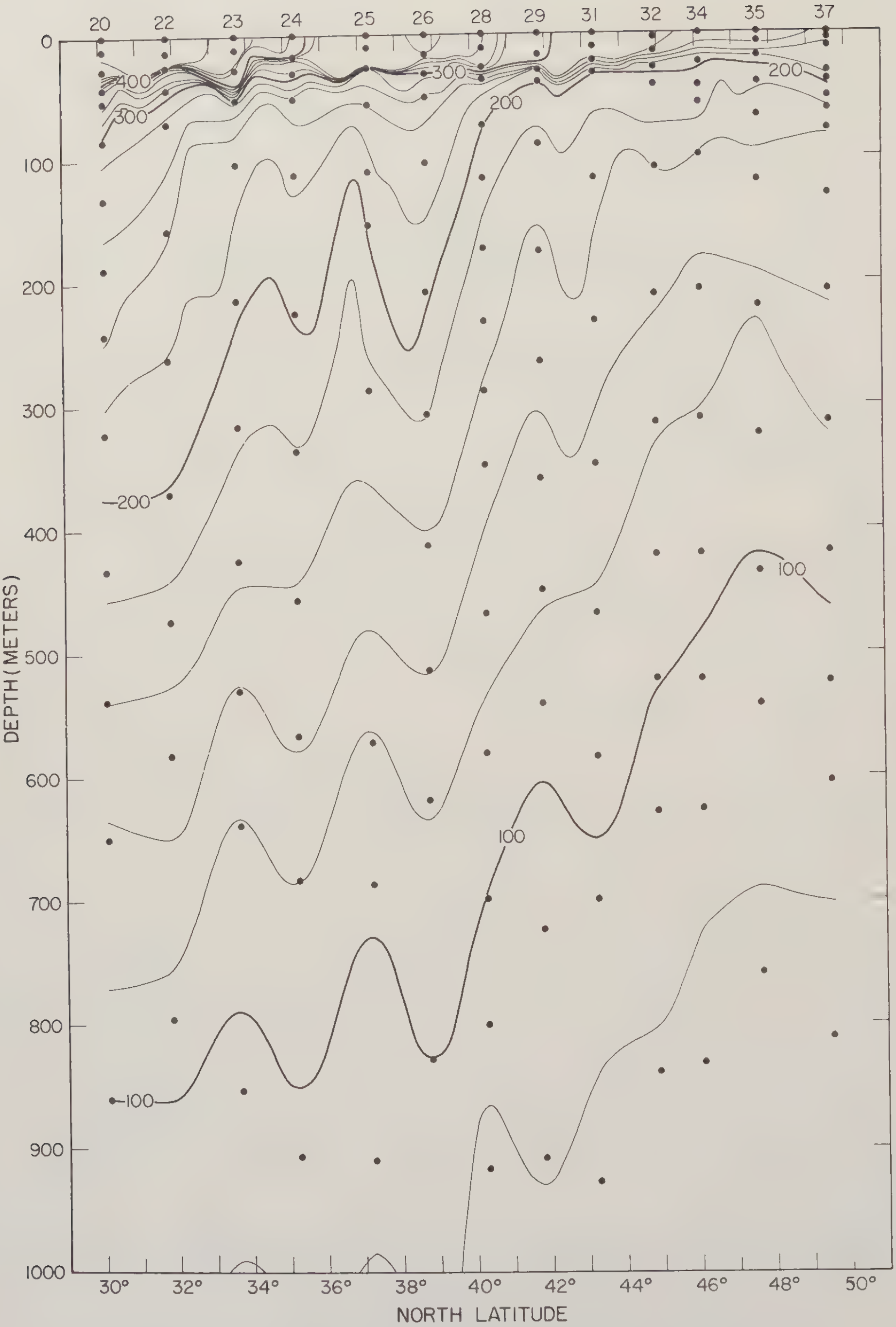


Figure 120.--Vertical section of a thermosteric anomaly in centiliters per ton along the 180th meridian; Hugh M. Smith cruise 30 (NORPAC), stations 20-37, July-August 1955. Contour interval 20 cl. /ton. Points indicate observed values.

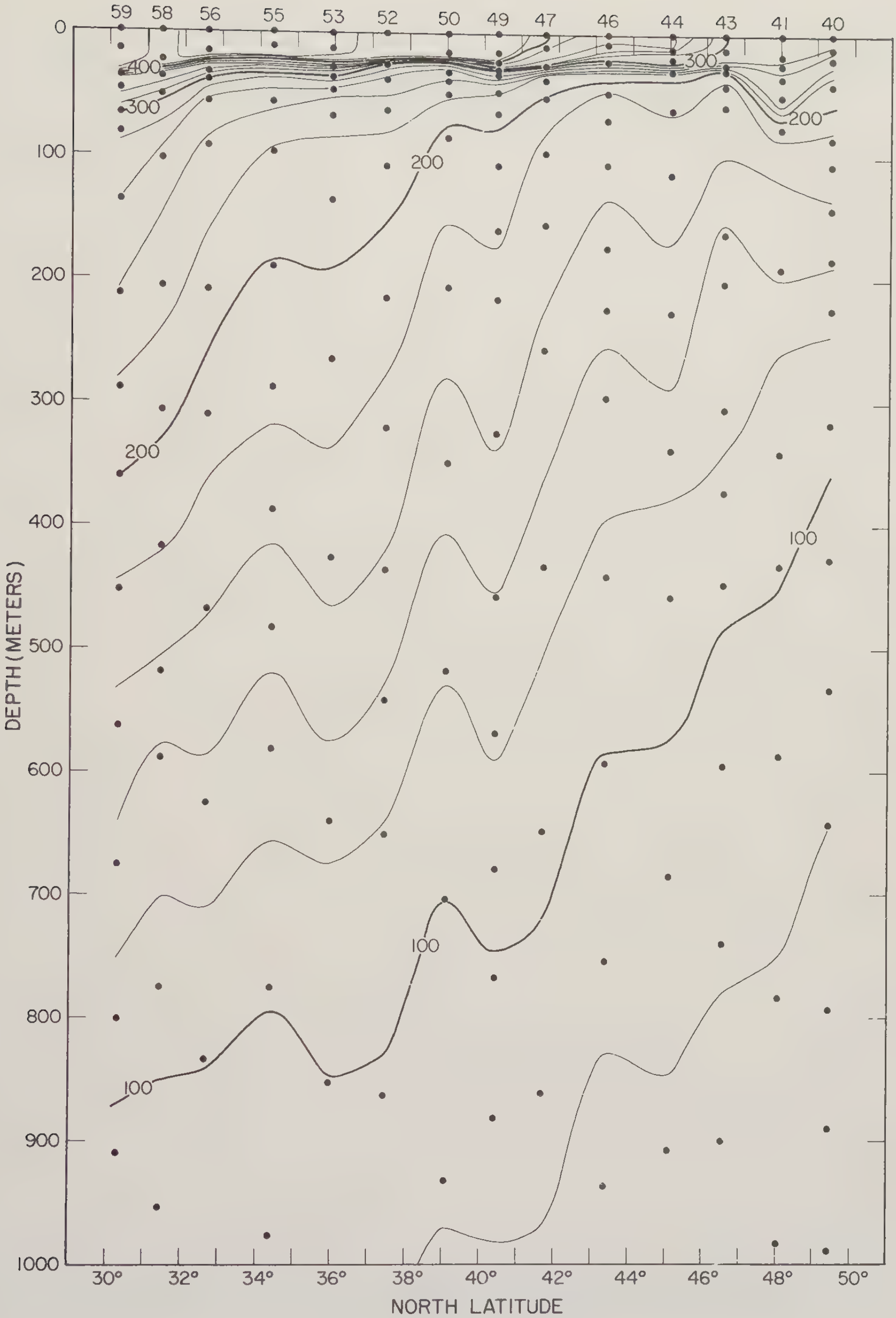


Figure 121.--Vertical section of a thermosteric anomaly in centiliters per ton along 172°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 40-59, July-August 1955. Contour interval 20 cl./ton. Points indicate observed values.

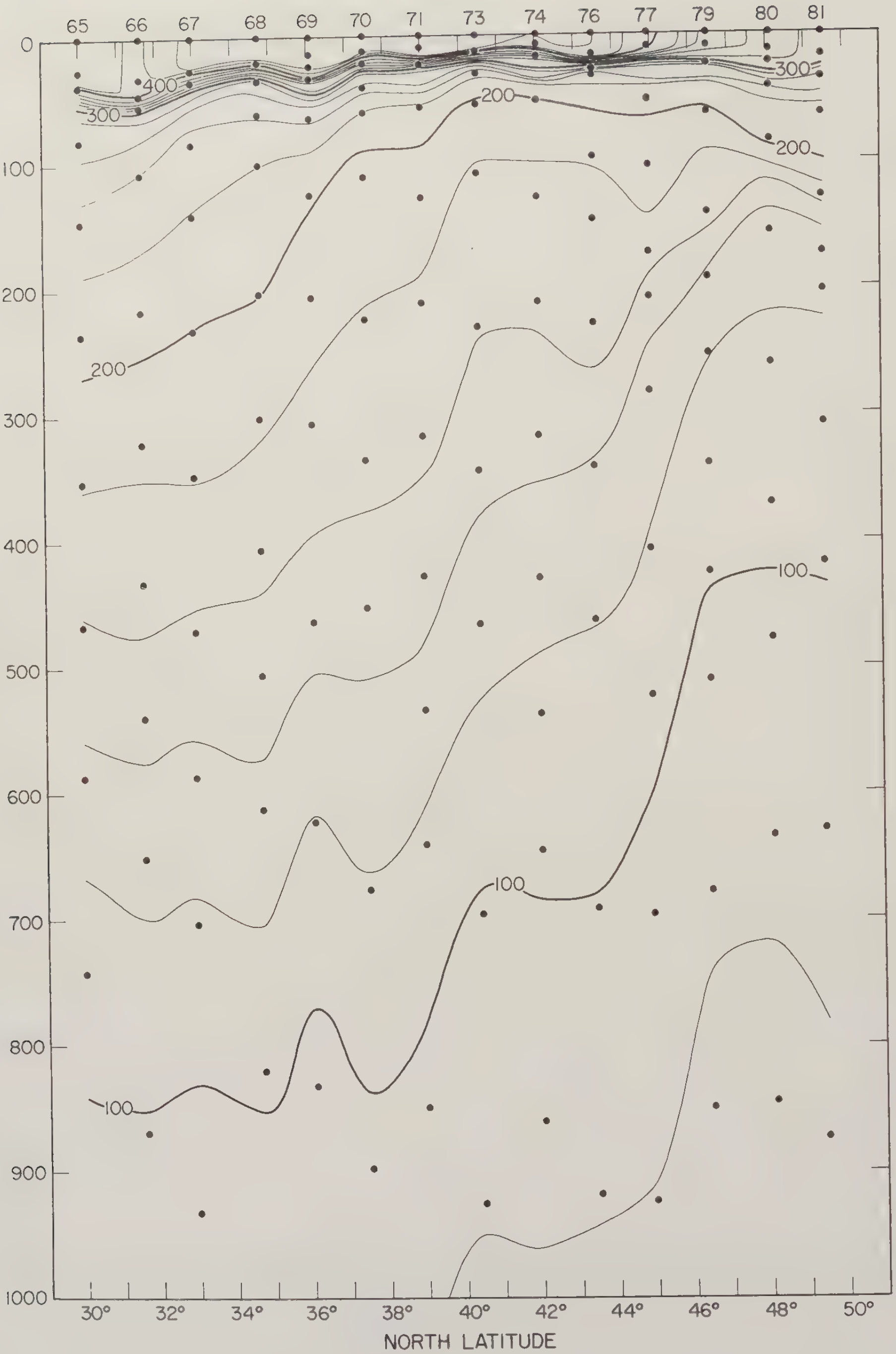


Figure 122.--Vertical section of a thermosteric anomaly in centiliters per ton along 165°W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 65-81, July-August 1955. Contour interval 20 cl./ton. Points indicate observed values.

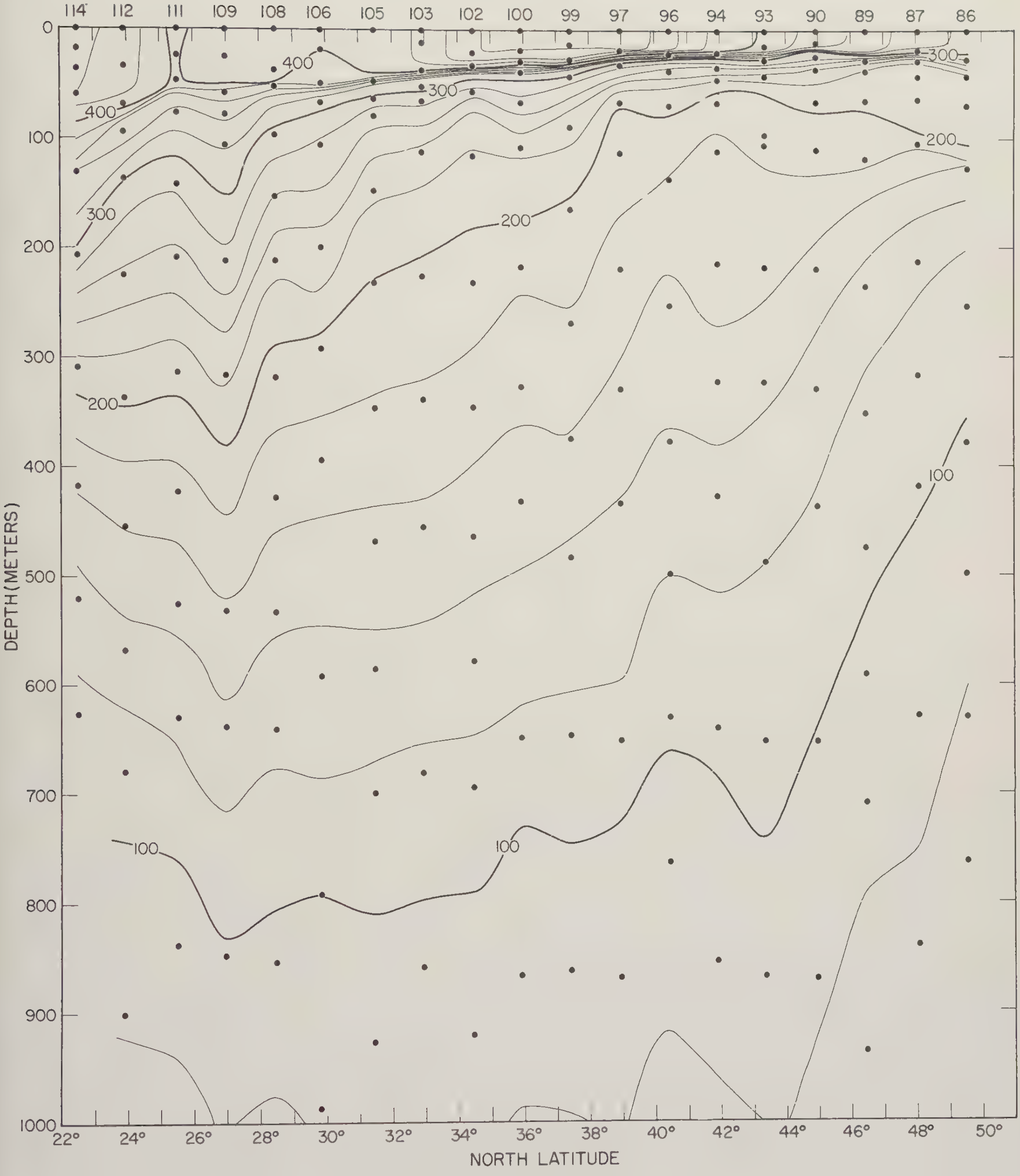


Figure 123.--Vertical section of a thermosteric anomaly in centiliters per ton along 157°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 86-114, July-August 1955. Contour interval 20 cl. /ton. Points indicate observed values.

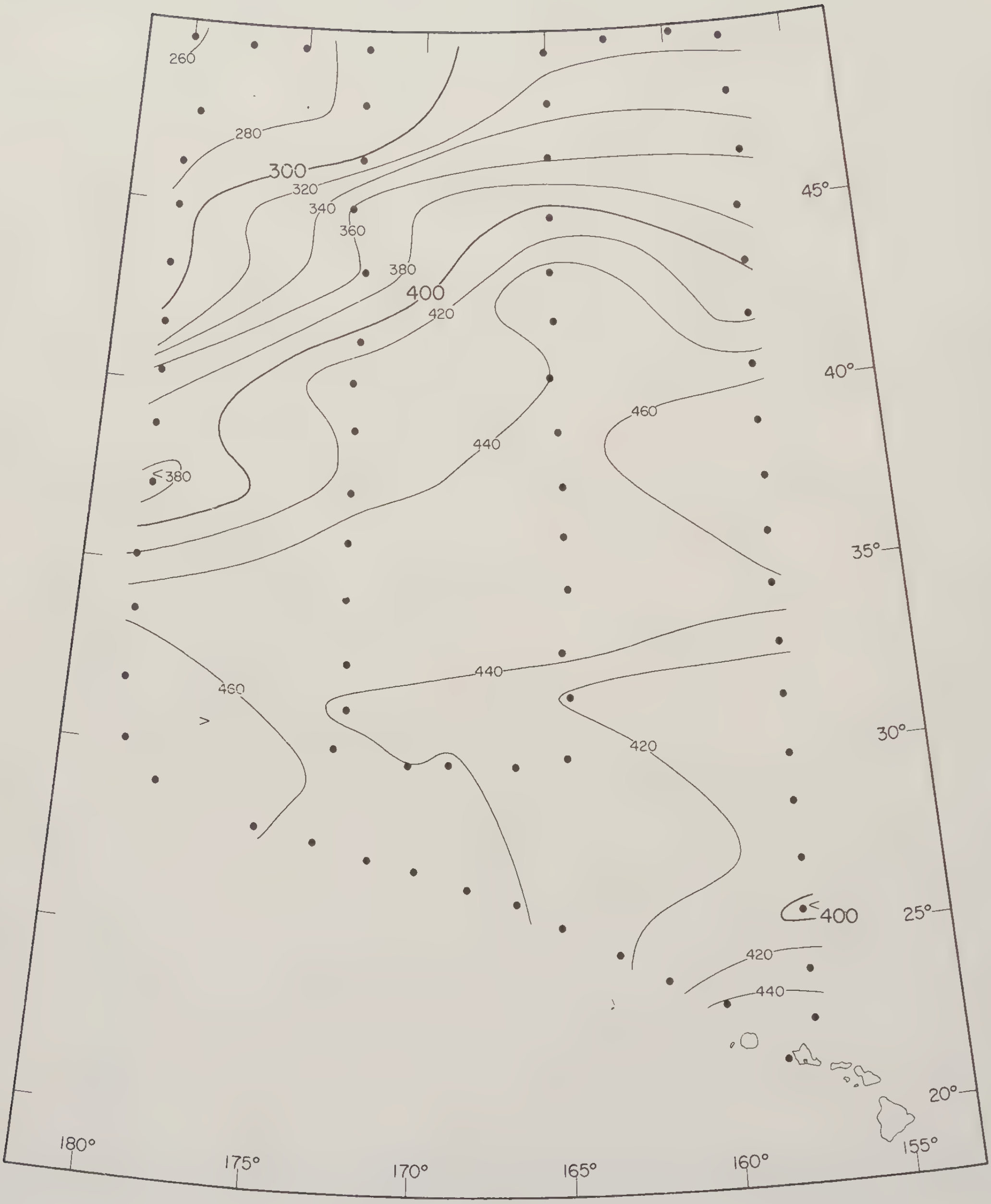

260
280
300
320
340
360
380
400
420
460
440
<380
460
>
440
420
<400
420
440
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°

Figure 124. --Surface thermosteric anomaly in centiliters per ton; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour interval 20 cl. /ton. Dots indicate station positions.

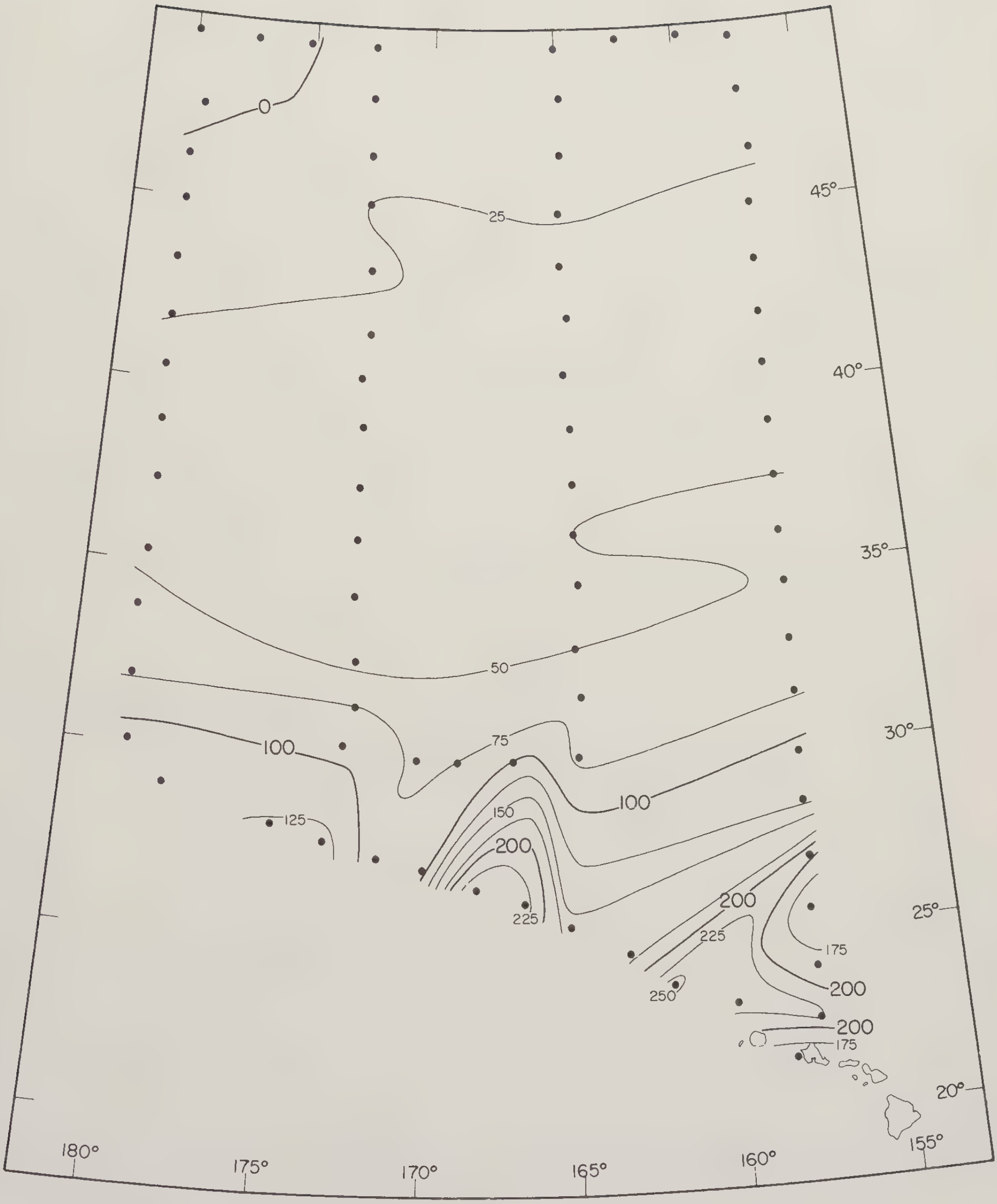

0
25
50
75
100
100
100
125
150
200
225
200
225
250
175
200
200
175
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°

Figure 125.--Depth of the 277.7 cl./ton (sigma-t 25.2) thermosteric anomaly surface in meters; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour interval 25 meters. Dots indicate station positions.

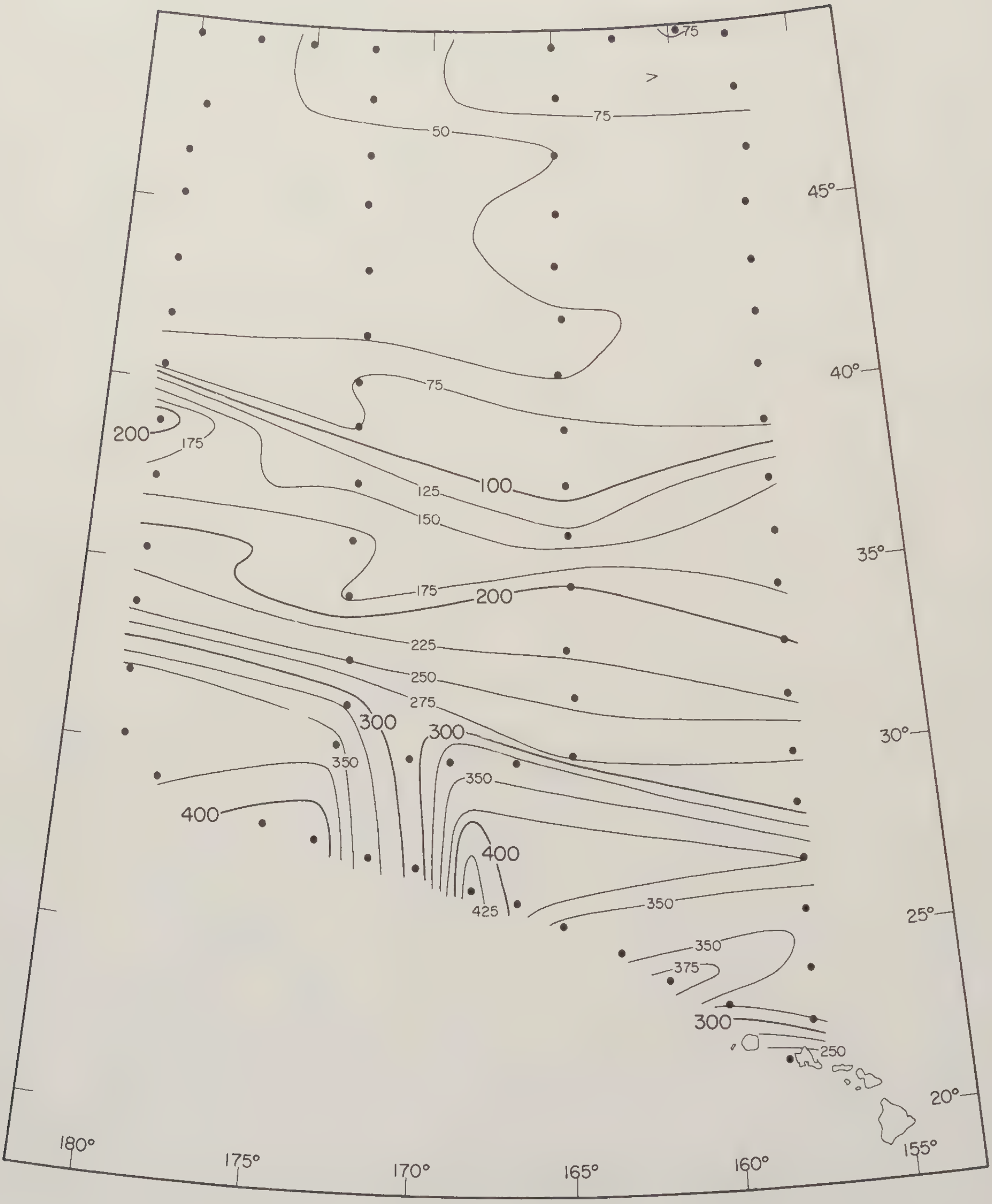

75
75
50
45°
40°
75
200
175
100
125
150
35°
175
200
225
250
275
300
300
30°
350
350
400
400
425
350
25°
350
375
300
250
20°
180°
175°
170°
165°
160°
155°

Figure 126.--Depth of the 201.7 cl./ton (sigma-t 26.0) thermosteric anomaly surface in meters; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour interval 25 meters. Dots indicate station positions.

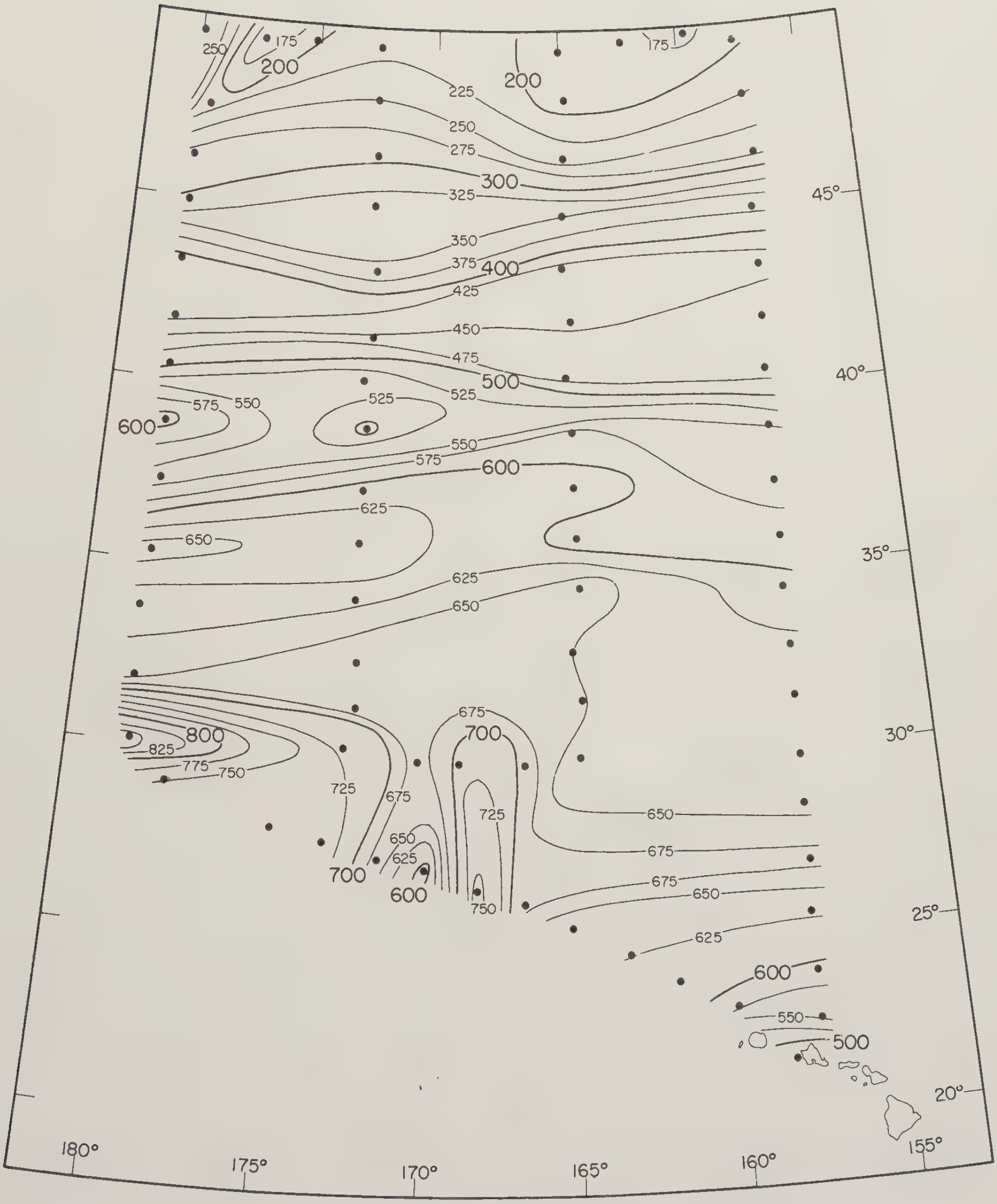

250
175
200
225
200
175
250
275
300
325
45°
350
375
400
425
450
475
500
525
40°
575
550
525
600
550
575
600
625
650
35°
625
650
675
700
800
825
775
750
30°
725
675
725
650
650
625
700
600
675
750
675
650
25°
625
600
550
500
20°
180°
175°
170°
165°
160°
155°

Figure 127.--Depth of the 125.5 cl./ton (sigma-t 26.8) thermosteric anomaly surface in meters; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour interval 25 meters. Dots indicate station positions.

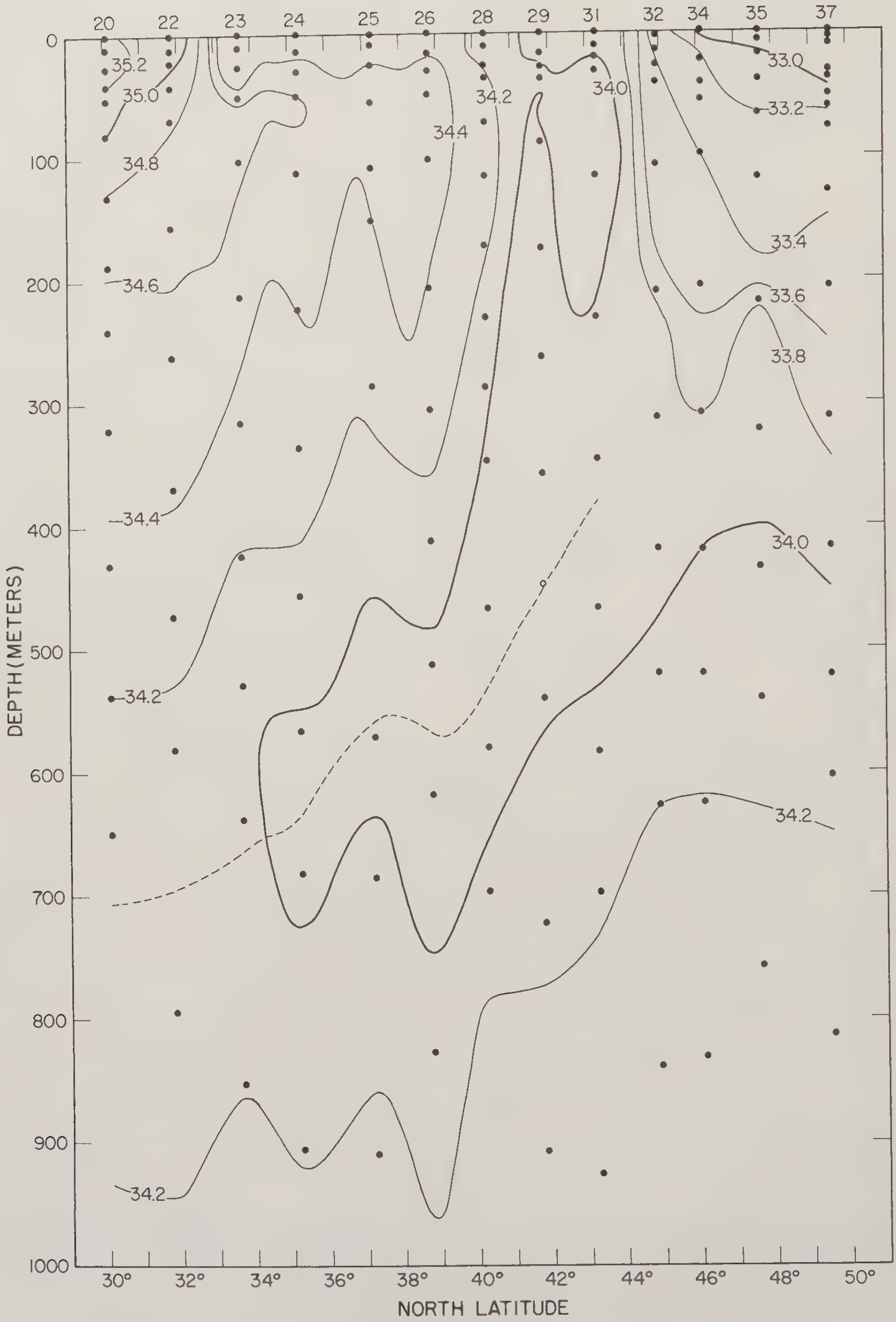


Figure 128.--Vertical section of salinity in parts per thousand along the 180th meridian; Hugh M. Smith cruise 30 (NORPAC), stations 20-37, July-August 1955. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.

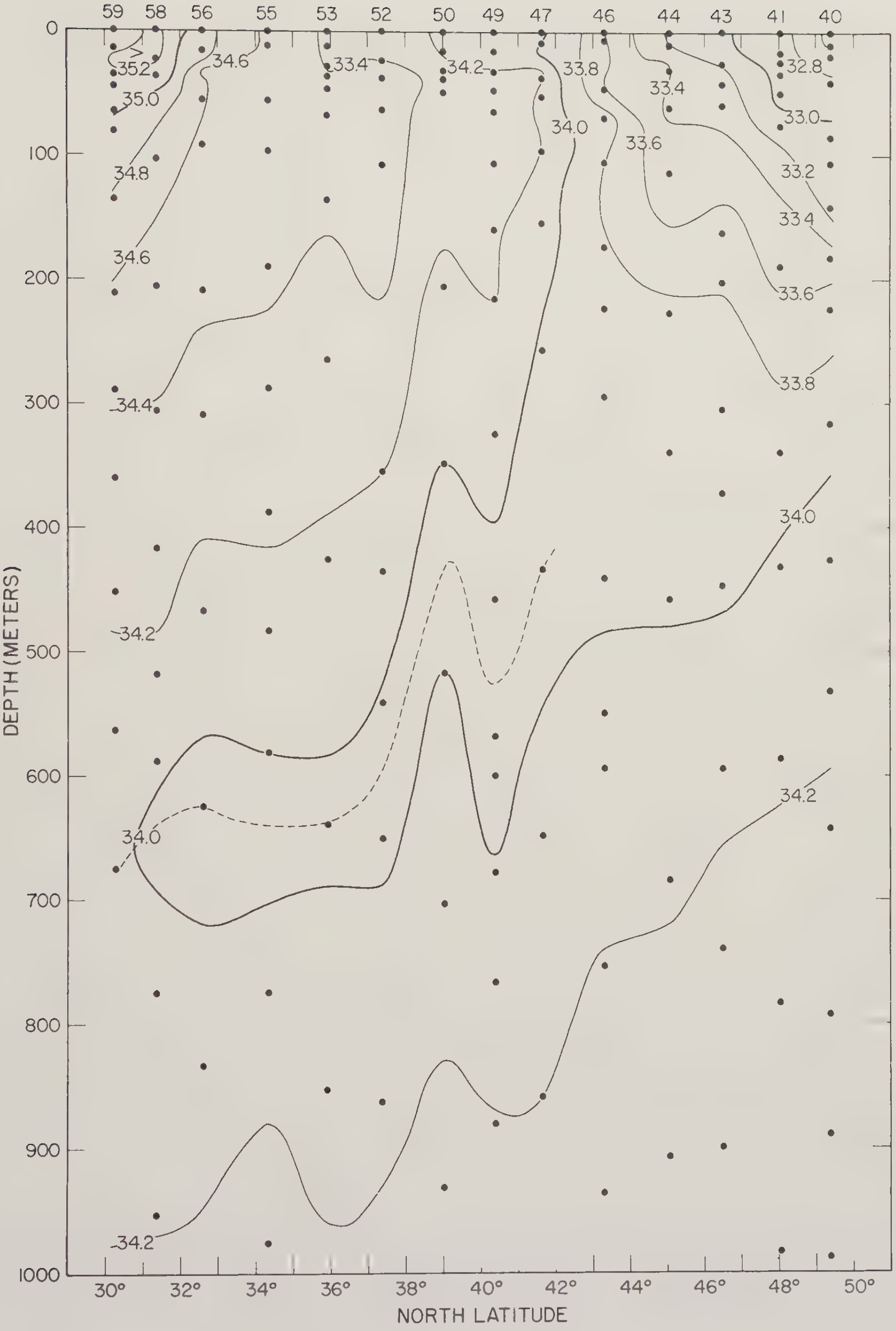


Figure 129.--Vertical section of salinity in parts per thousand along 172°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 40-59, July-August 1955. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.

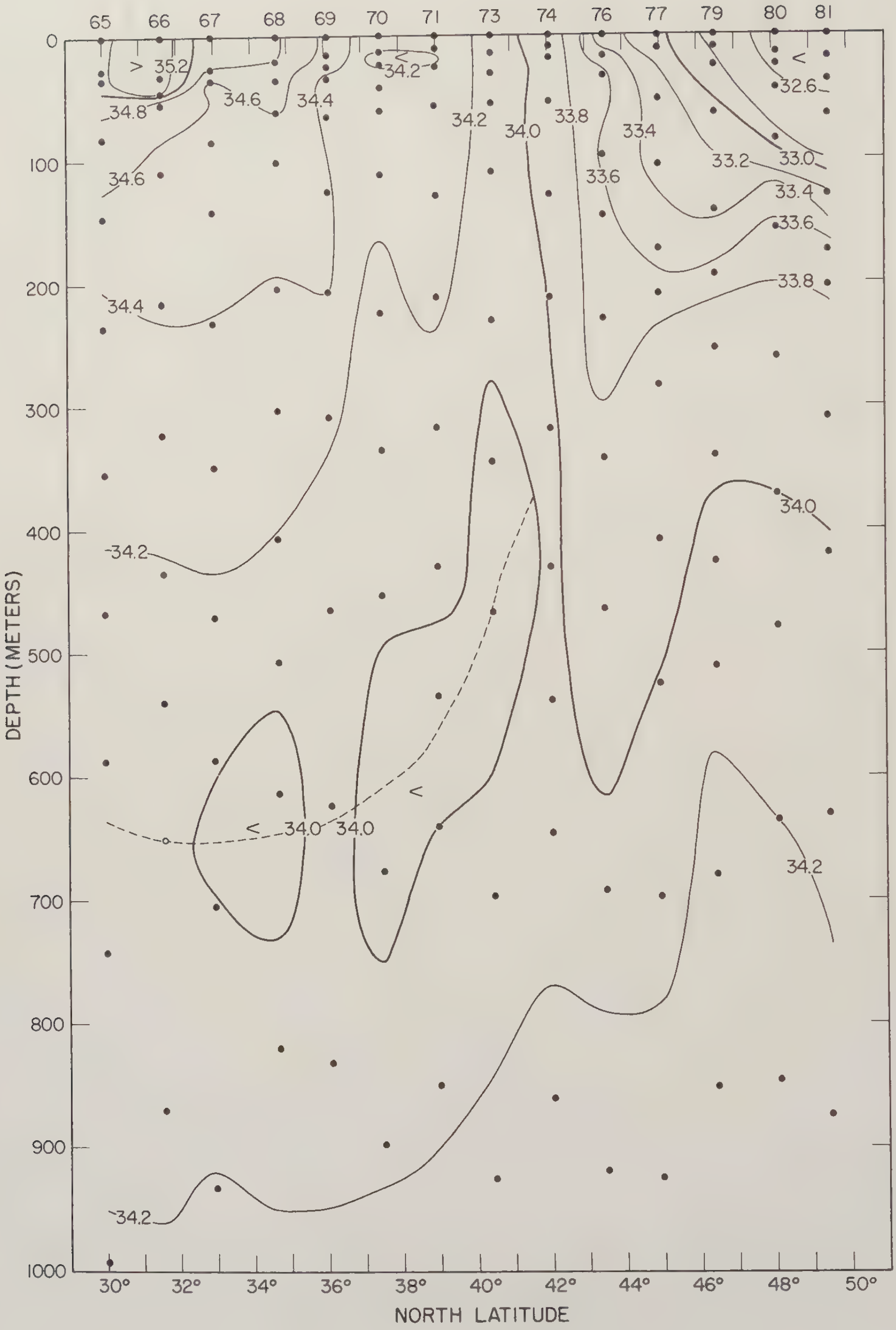


Figure 130.--Vertical section of salinity in parts per thousand along 165°W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 65-81, July-August 1955. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.

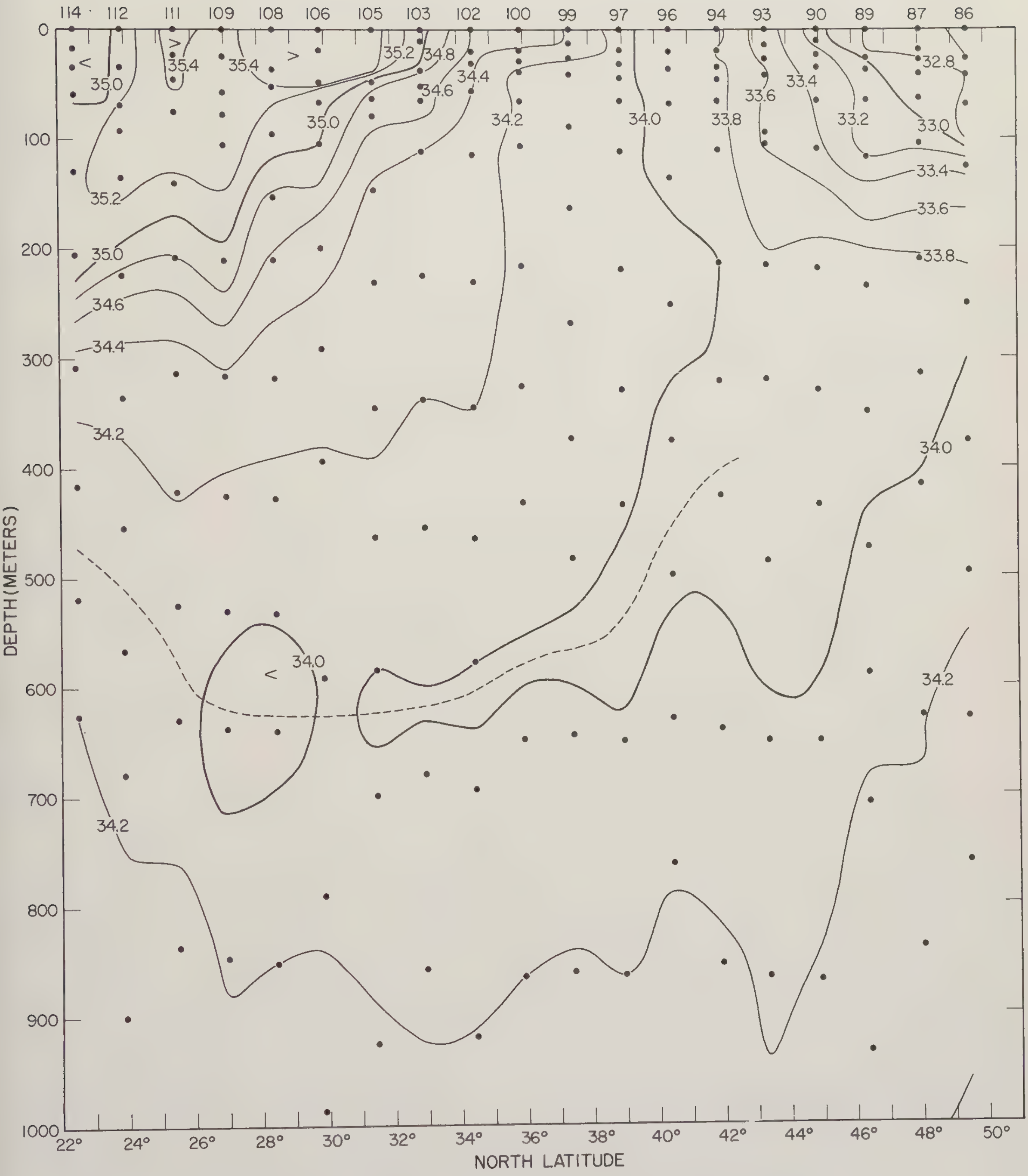


Figure 131.--Vertical section of salinity in parts per thousand along 157°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 86-114, July-August 1955. Contour interval 0.2 ‰. Points indicate observed values. Dotted line indicates depth of salinity minima.

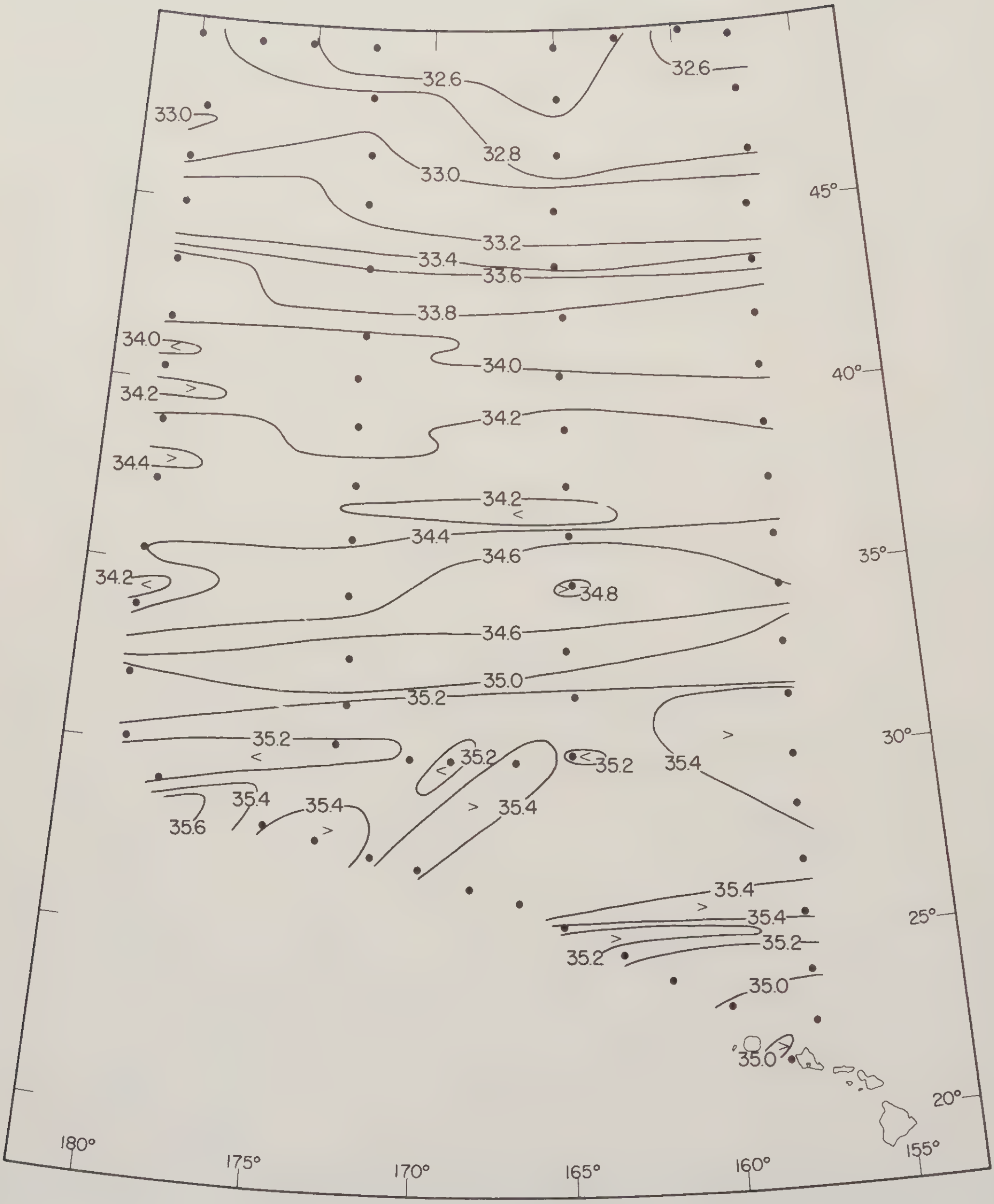

32.6
32.6
33.0
32.8
33.0
45°
33.2
33.4
33.6
33.8
34.0
34.0
40°
34.2
34.2
34.4
34.2
34.4
34.6
35°
34.2
34.8
34.6
35.0
35.2
30°
35.2
35.2
35.2
35.4
35.4
35.6
35.4
35.4
35.4
25°
35.4
35.2
35.2
35.0
35.0
20°
180°
175°
170°
165°
160°
155°

Figure 132.--Surface salinity in parts per thousand; Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour interval 0.2 ‰.

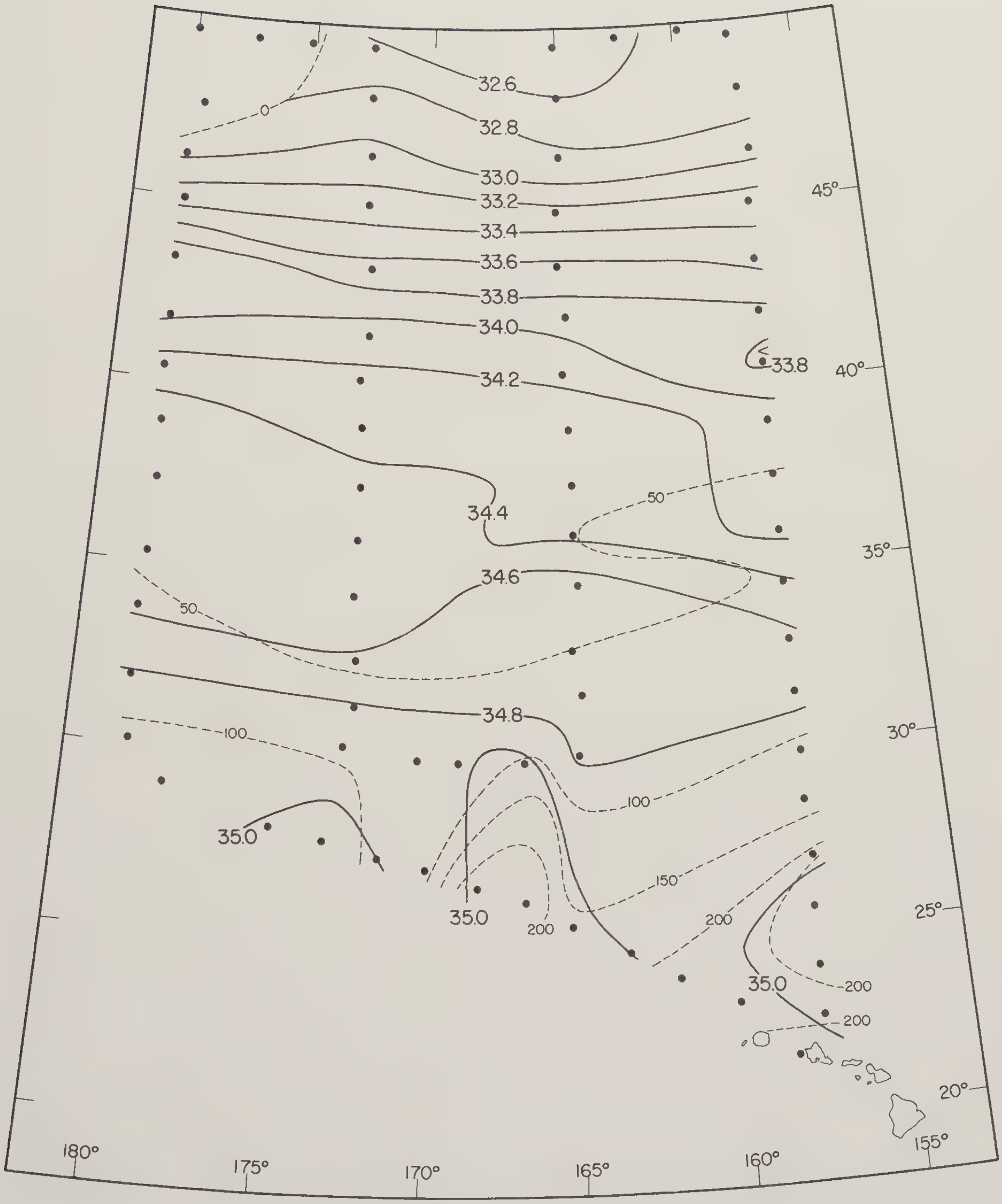

32.6
32.8
33.0
33.2
33.4
33.6
33.8
34.0
34.2
34.4
34.6
34.8
35.0
35.0
35.0
<33.8
0
50
50
100
100
150
200
200
200
200
45°
40°
35°
30°
25°
20°
155°
180°
175°
170°
165°
160°

Figure 133.--Salinity in parts per thousand (solid lines) on the 277.7 cl./ton thermosteric anomaly (25.2 sigma-t) surface (depth in meters, dotted lines); Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour intervals: salinity 0.2 ‰, depth of the thermosteric anomaly surface 50 m. Dots indicate station positions.

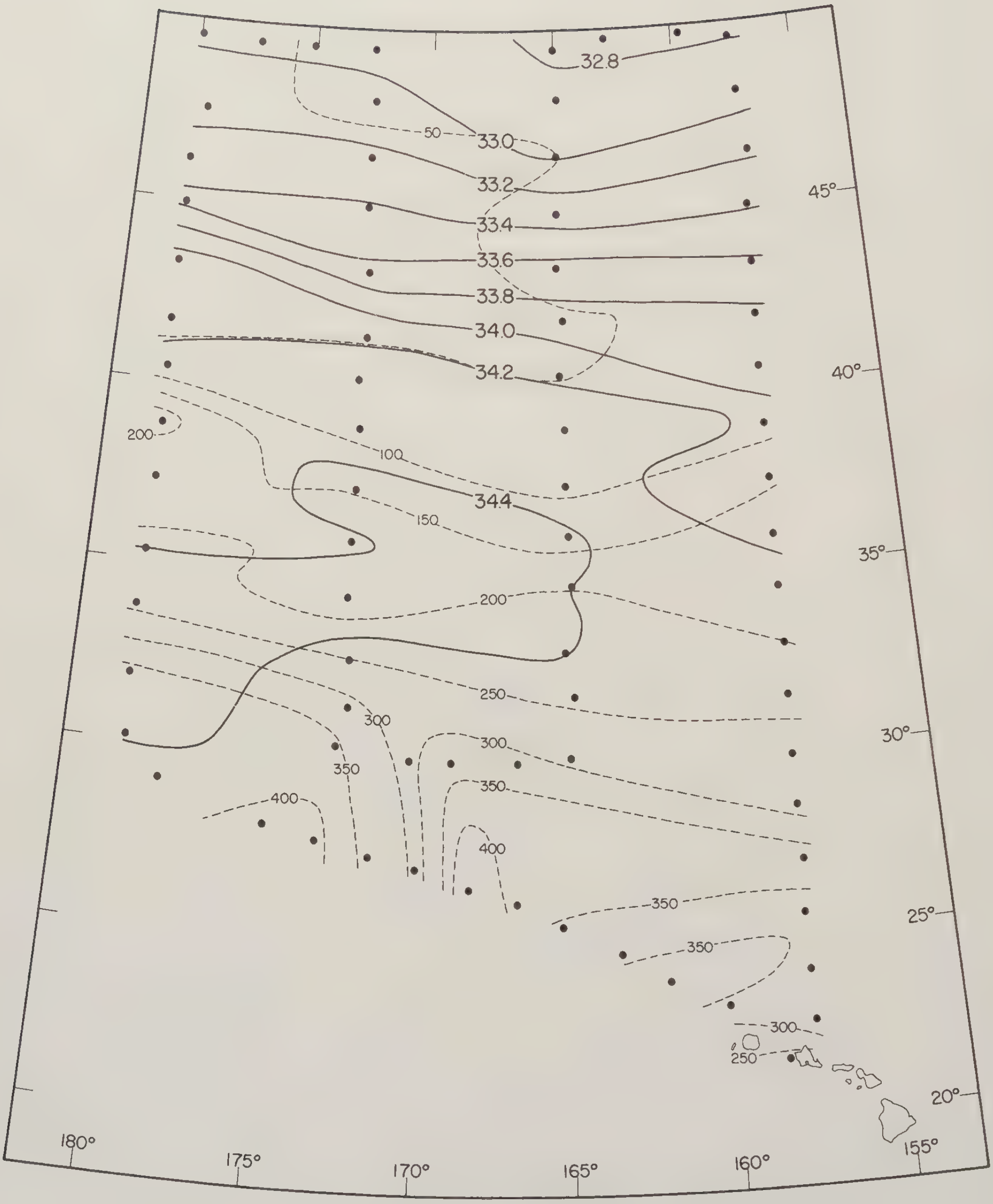

32.8
33.0
33.2
33.4
33.6
33.8
34.0
34.2
34.4
50
100
150
200
250
300
350
400
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°

Figure 134.--Salinity in parts per thousand (solid lines) on the 201.7 cl./ton thermosteric anomaly (26.0 sigma-t) surface (depth in meters, dotted lines); Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour intervals: salinity 0.2 ‰, depth of the thermosteric anomaly surface 50 m. Dots indicate station positions.

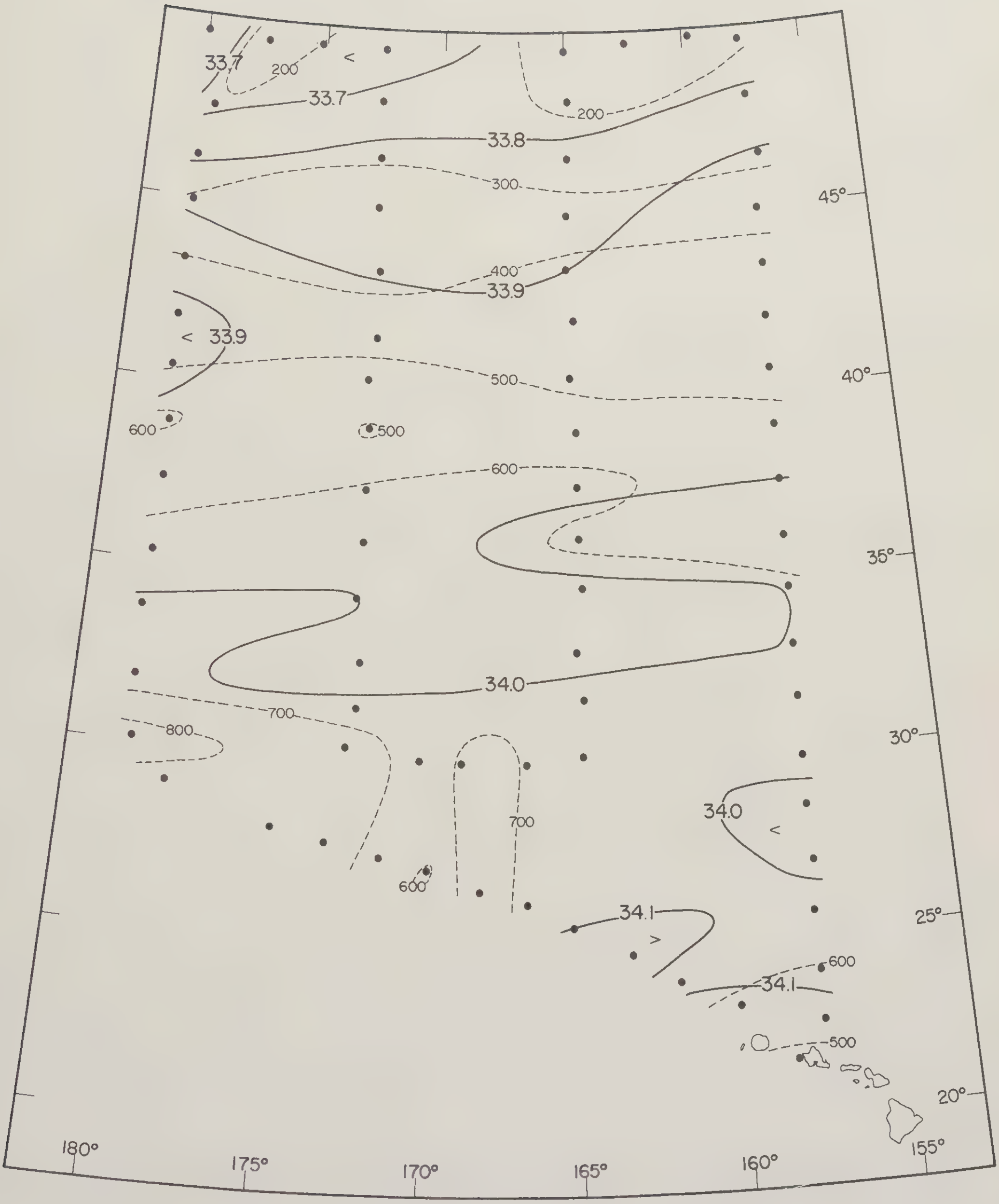

33.7
200
33.7
200
33.8
300
45°
400
33.9
33.9
40°
500
600
500
600
35°
34.0
700
800
30°
700
34.0
600
34.1
25°
600
34.1
500
20°
180°
175°
170°
165°
160°
155°

Figure 135.--Salinity in parts per thousand (solid lines) on the 125.5 cl./ton thermosteric anomaly (26.8 sigma-t) surface (depths in meters, dotted lines); Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour intervals: salinity 0.1 ‰, depth of the thermosteric anomaly surface 100 m. Dots indicate station positions.

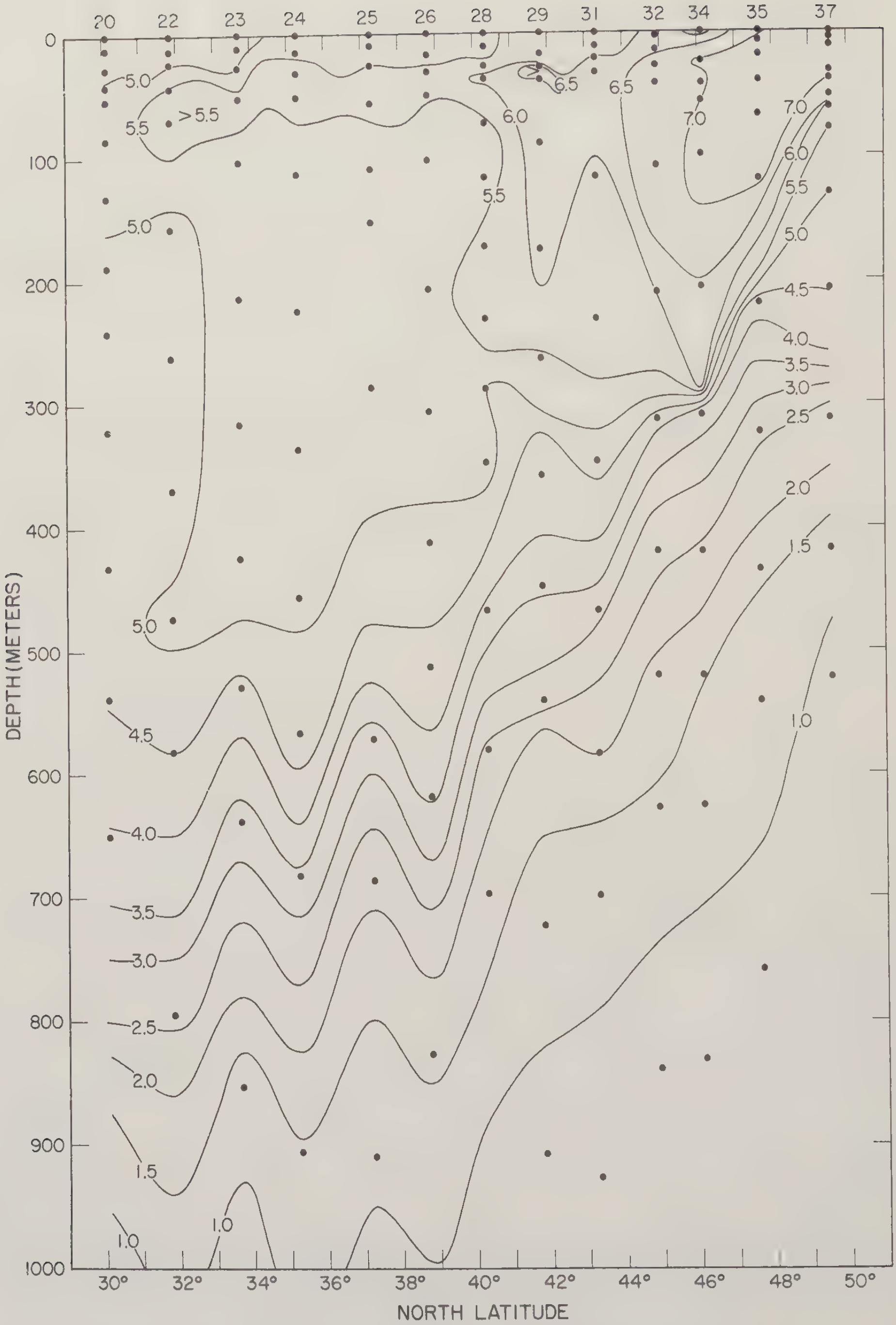


Figure 136.--Vertical section of dissolved oxygen in milliliters per liter along the 180th meridian; Hugh M. Smith cruise 30 (NORPAC), stations 20-37, July-August 1955. Contour interval 0.5 ml./l. Points indicate observed values.

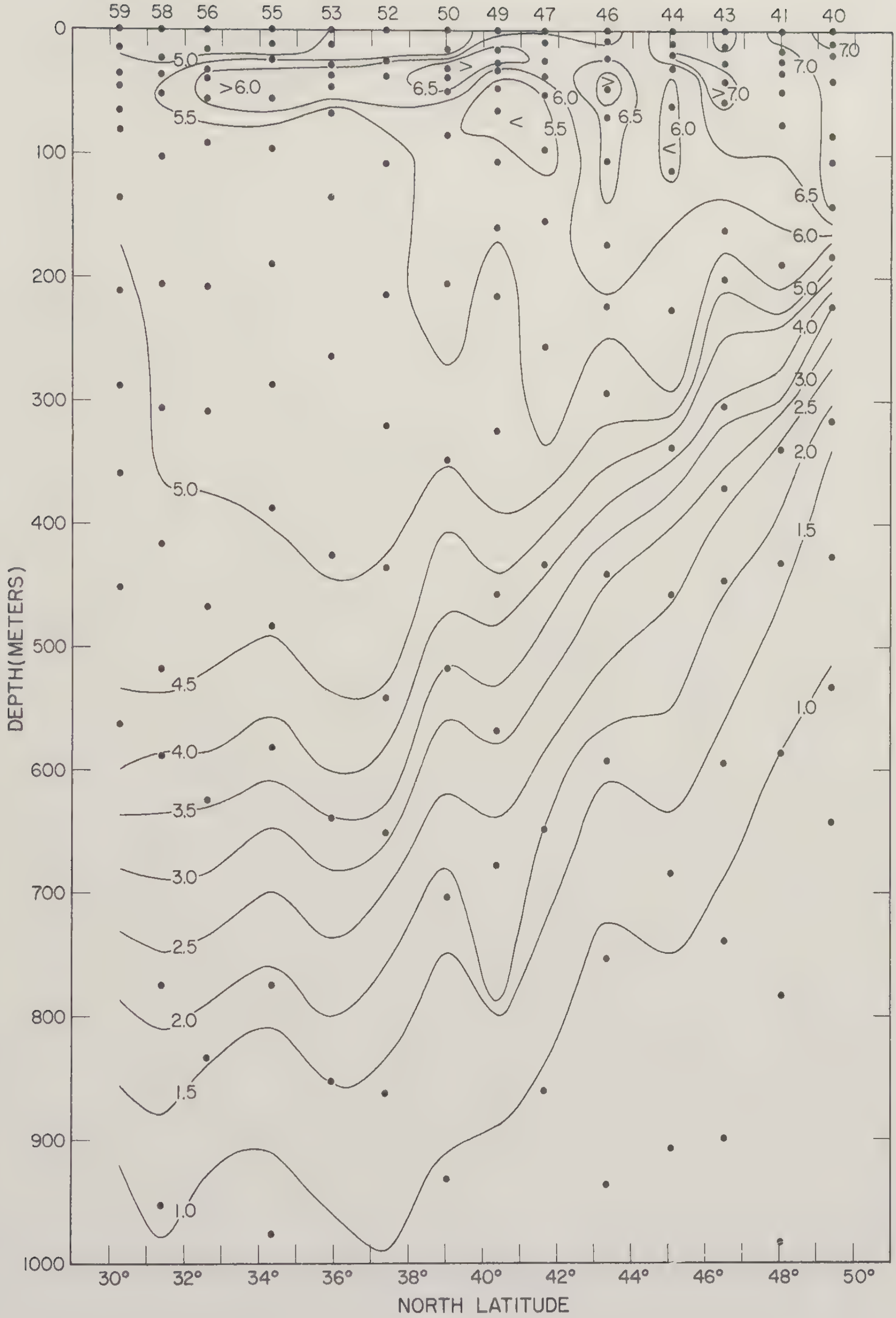


Figure 137.--Vertical section of dissolved oxygen in milliliters per liter along 172°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 40-59, July-August 1955. Contour interval 0.5 ml./l. Points indicate observed values.

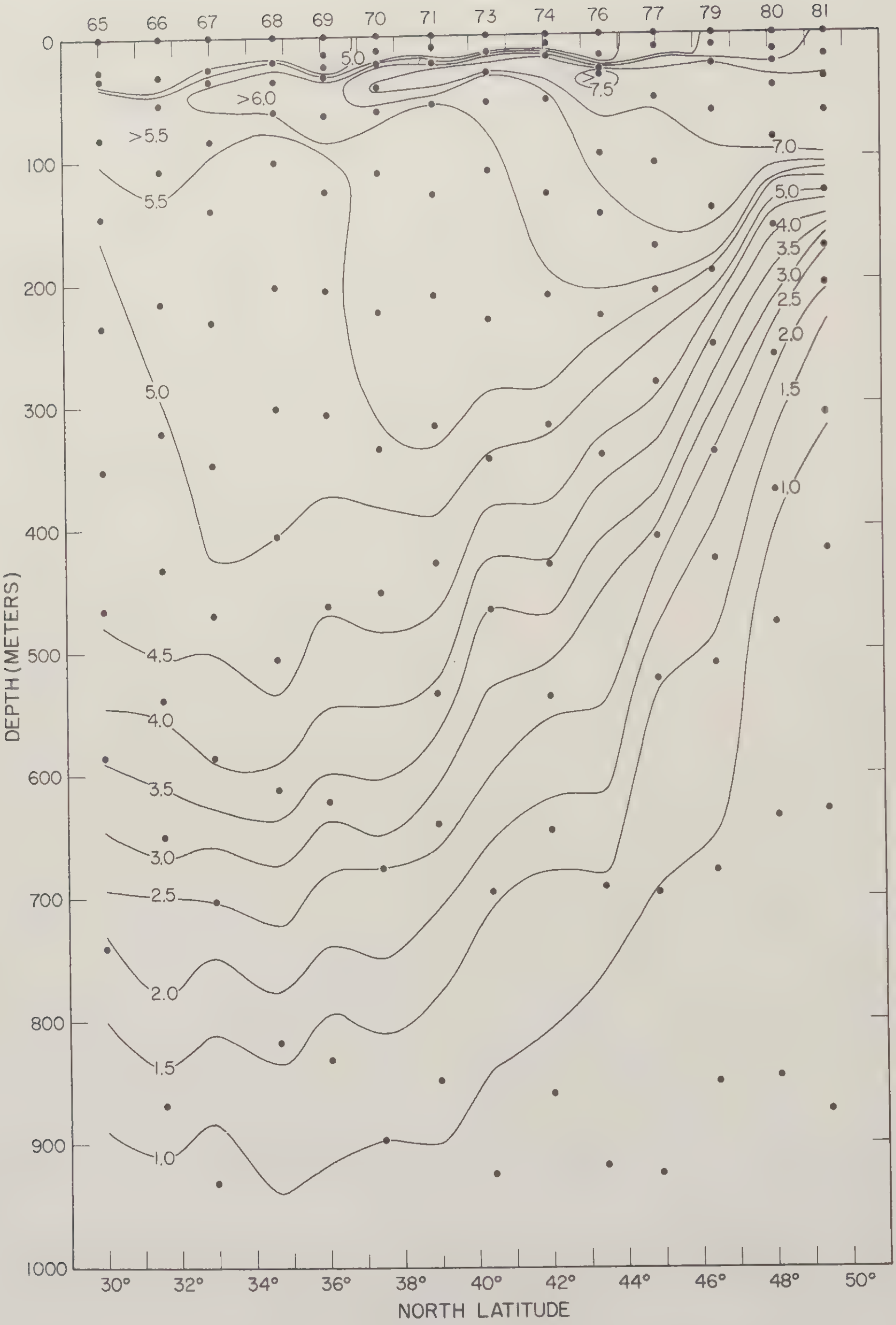


Figure 138.--Vertical section of dissolved oxygen in milliliters per liter along 165°W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 65-81, July-August 1955. Contour interval 0.5 ml./l. Points indicate observed values.

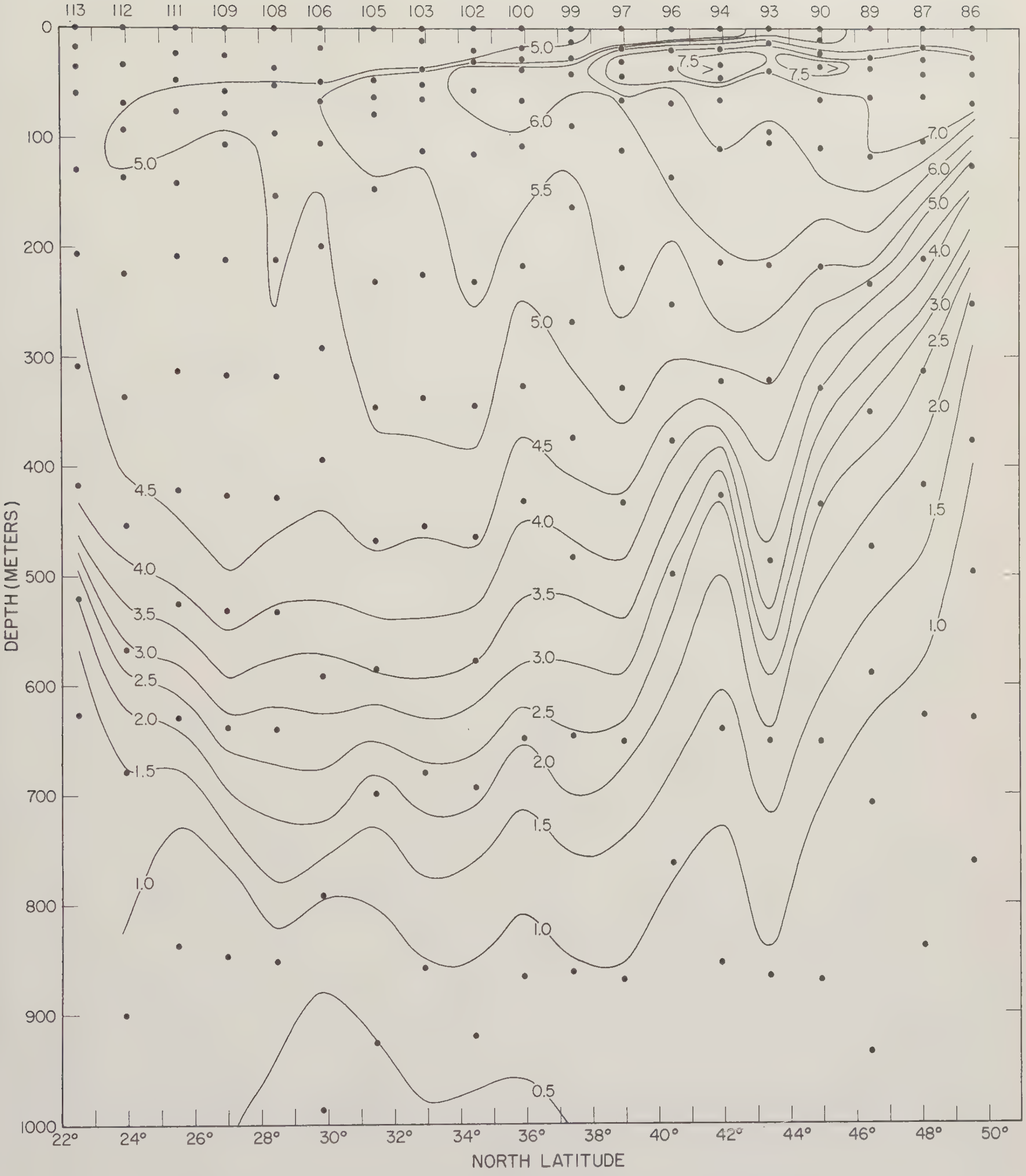


Figure 139.--Vertical section of dissolved oxygen in milliliters per liter along 157°30'W. longitude; Hugh M. Smith cruise 30 (NORPAC), stations 86-114, July-August 1955. Contour interval 0.5 ml. /l. Points indicate observed values.

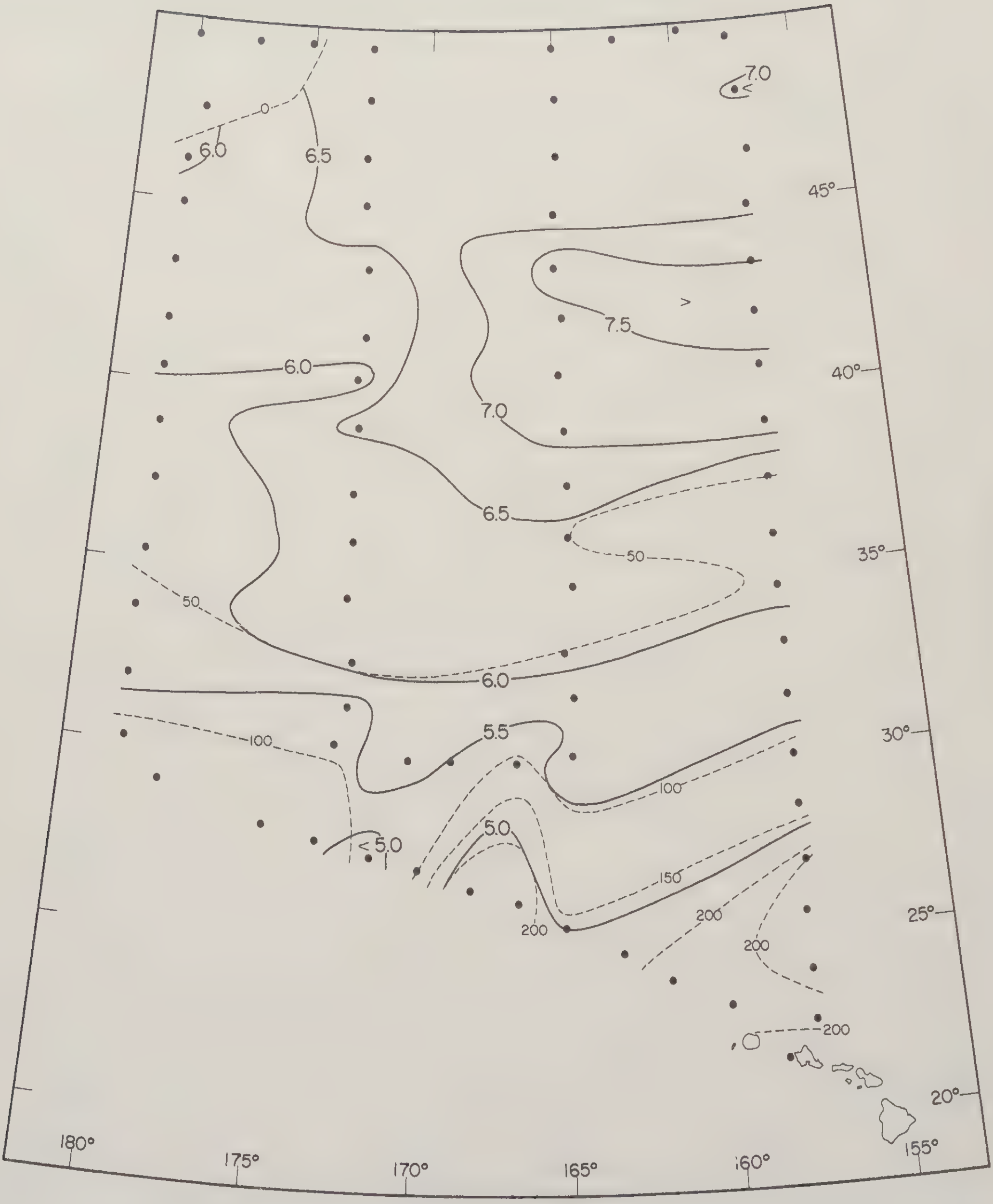

7.0
<
0
6.0
6.5
45°
>
7.5
40°
6.0
7.0
6.5
50
35°
50
6.0
30°
5.5
100
100
< 5.0
5.0
150
25°
200
200
200
200
20°
180°
175°
170°
165°
160°
155°

Figure 140. --Dissolved oxygen in milliliters per liter (solid lines) on the 277.7 cl. /ton thermosteric anomaly (sigma-t 25.2) surface (depth in meters, dotted lines), Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour intervals: dissolved oxygen 0.5 ml. /l., depth of thermosteric anomaly surface 50 m.

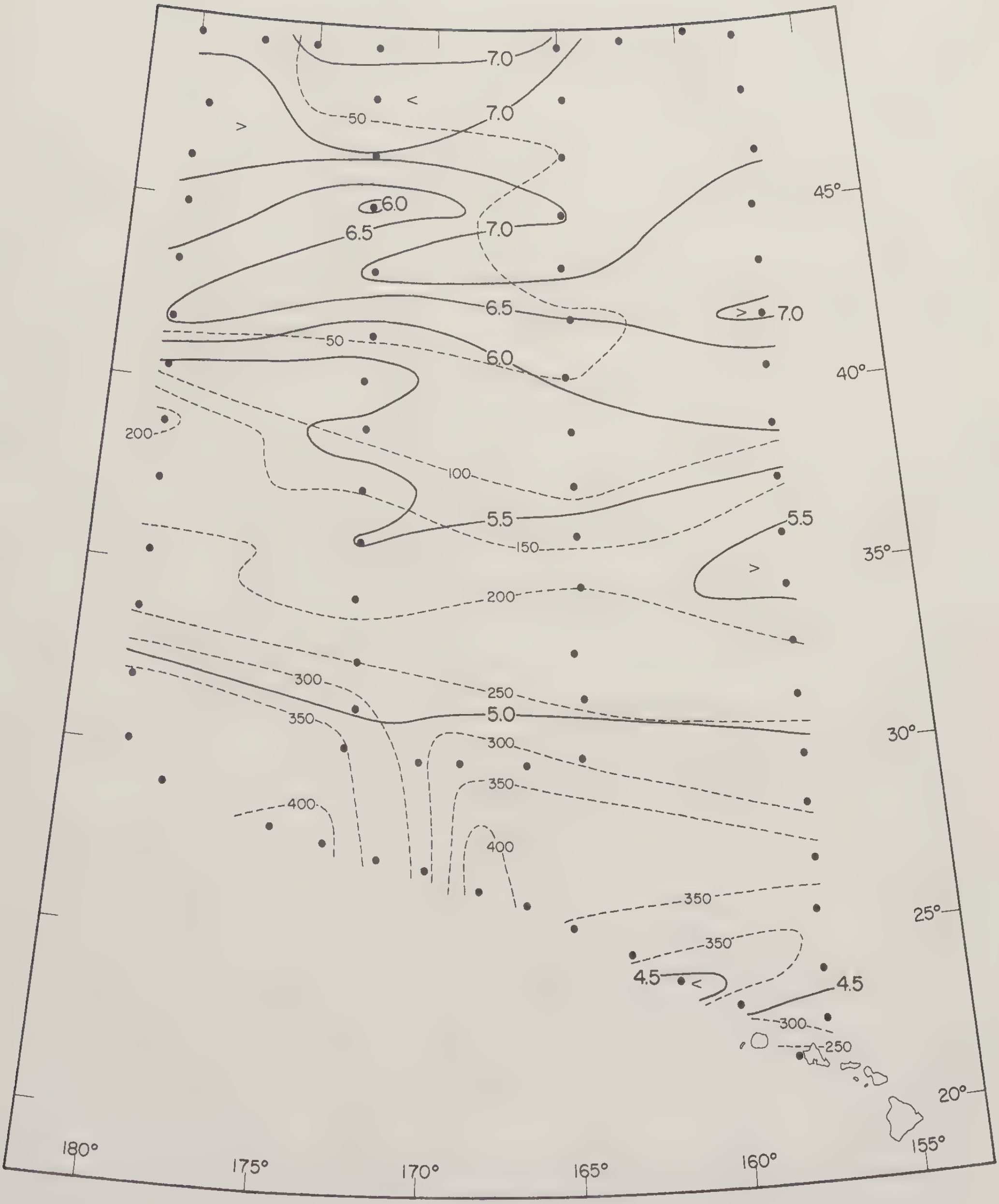

7.0
7.0
50
6.0
6.5
7.0
6.5
7.0
50
6.0
200
100
5.5
5.5
150
200
300
250
5.0
350
300
350
400
400
350
350
4.5
4.5
300
250
45°
40°
35°
30°
25°
20°
180°
175°
170°
165°
160°
155°

Figure 141.--Dissolved oxygen in milliliters per liter (solid lines) on the 201.7 cl./ton thermosteric anomaly (sigma-t 26.0) surface (depth in meters, dotted lines), Hugh M. Smith cruise 30 (NCRPAC), July-August 1955. Contour intervals: dissolved oxygen 0.5 ml./l., depth of thermosteric anomaly surface 50 m.

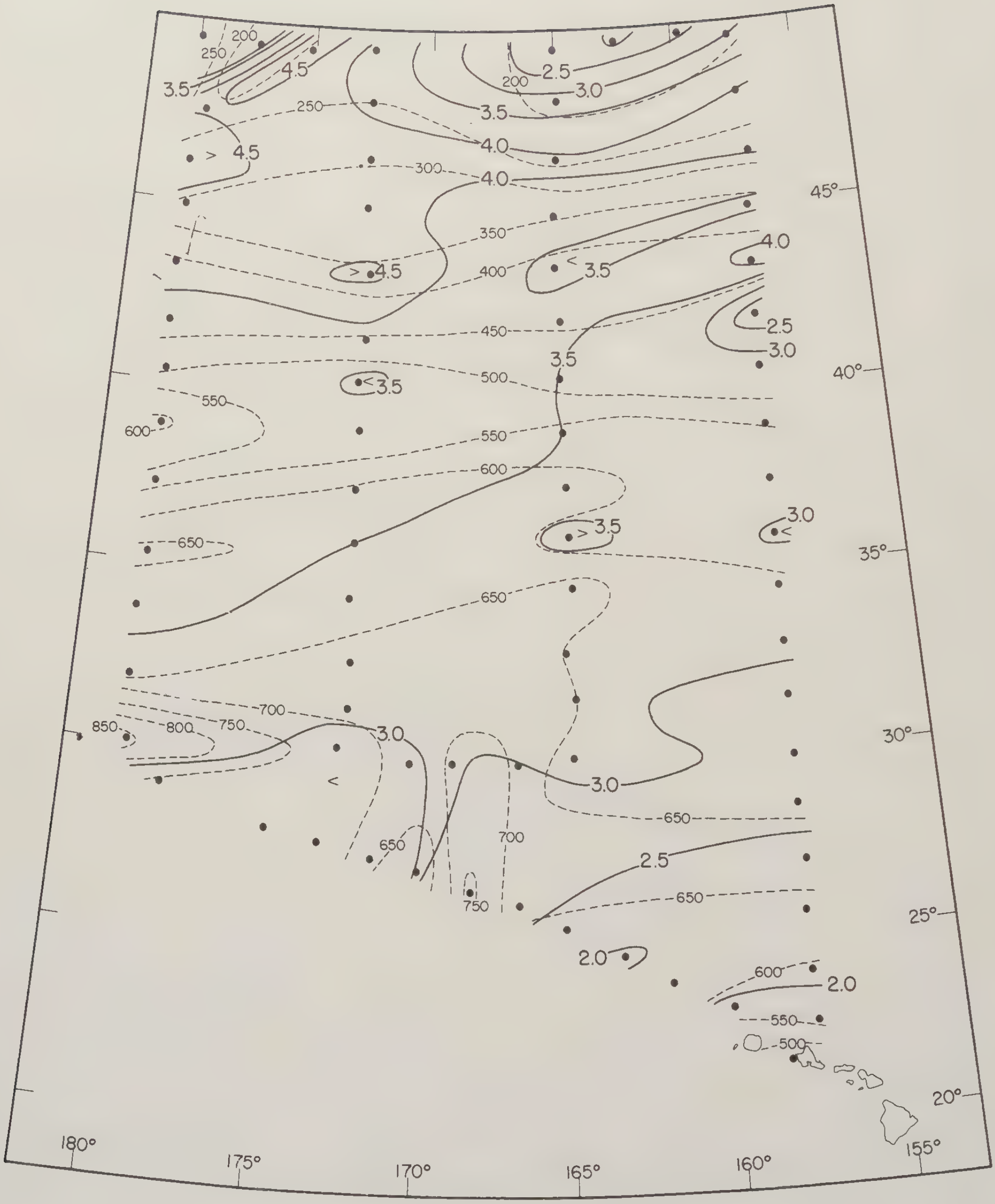

200
250
3.5
4.5
250
2.5
200
3.0
3.5
> 4.5
4.0
300
4.0
45°
350
> 4.5
400
< 3.5
4.0
2.5
3.0
450
3.5
40°
500
< 3.5
550
600
550
600
> 3.5
3.0
<
35°
650
650
700
850
800
750
3.0
30°
<
3.0
650
650
700
2.5
750
650
25°
2.0
600
2.0
550
500
20°
180°
175°
170°
165°
160°
155°

Figure 142.--Dissolved oxygen in milliliters per liter (solid lines) on the 125.5 cl./ton thermosteric anomaly (sigma-t 26.8) surface (depth in meters, dotted lines), Hugh M. Smith cruise 30 (NORPAC), July-August 1955. Contour intervals: dissolved oxygen 0.5 ml./l., depth of thermosteric anomaly surface 50 m.

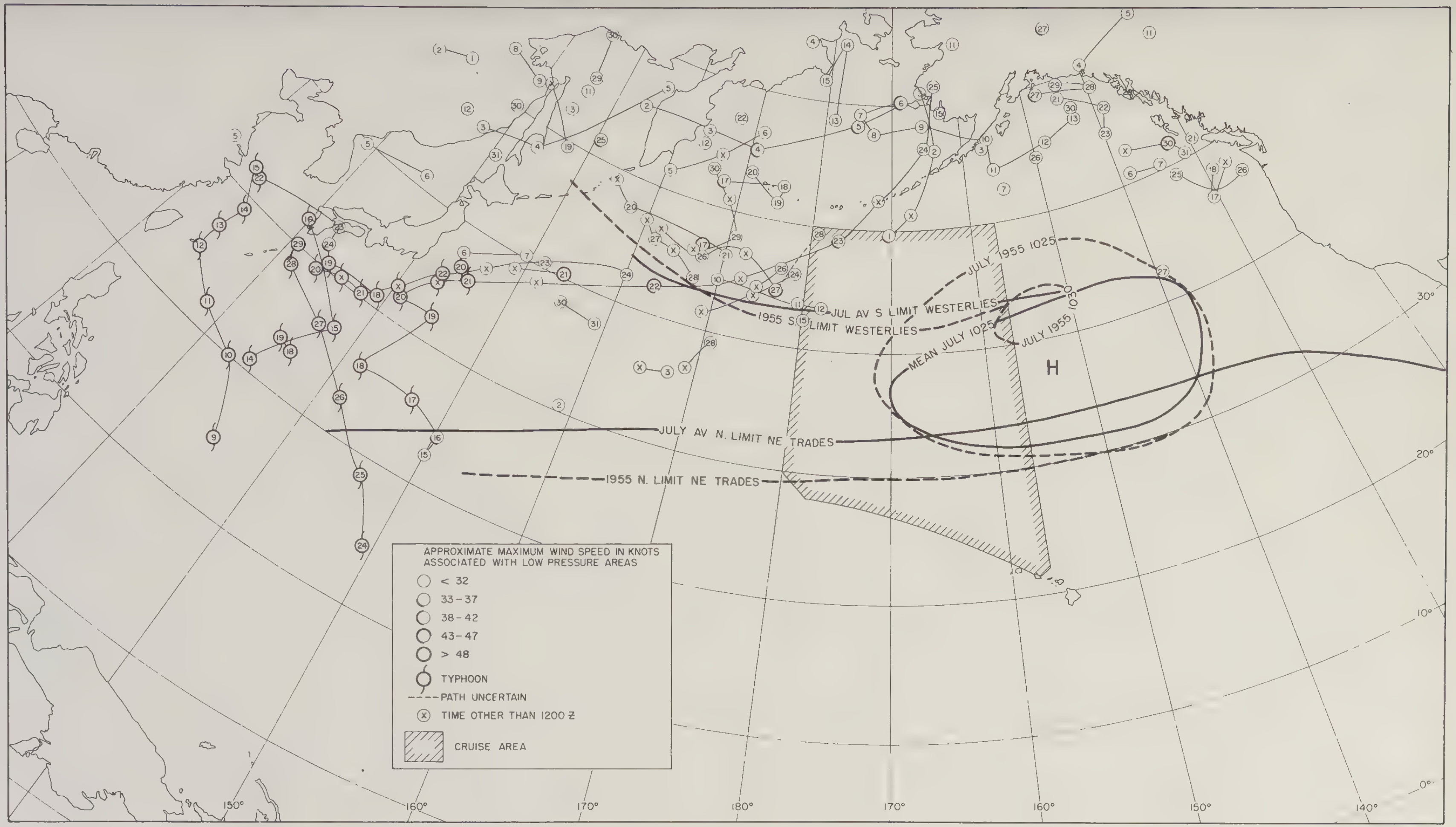

APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS
< 32
33 - 37
38 - 42
43 - 47
> 48
TYPHOON
PATH UNCERTAIN
TIME OTHER THAN 1200 Z
CRUISE AREA
JULY 1955 1025
1030
JULY 1955
MEAN JULY 1025
H
JUL AV S LIMIT WESTERLIES
1955 S LIMIT WESTERLIES
JULY AV N. LIMIT NE TRADES
1955 N. LIMIT NE TRADES
30°
20°
10°
0°
150°
160°
170°
180°
170°
160°
150°
140°

Figure 143. --Normal (heavy solid lines) and mean July 1955 (broken lines) position of the Eastern North Pacific High; normal and 1955 mean monthly limits of the northeast trades and westerlies; tracks of centers of low pressure areas showing daily positions.

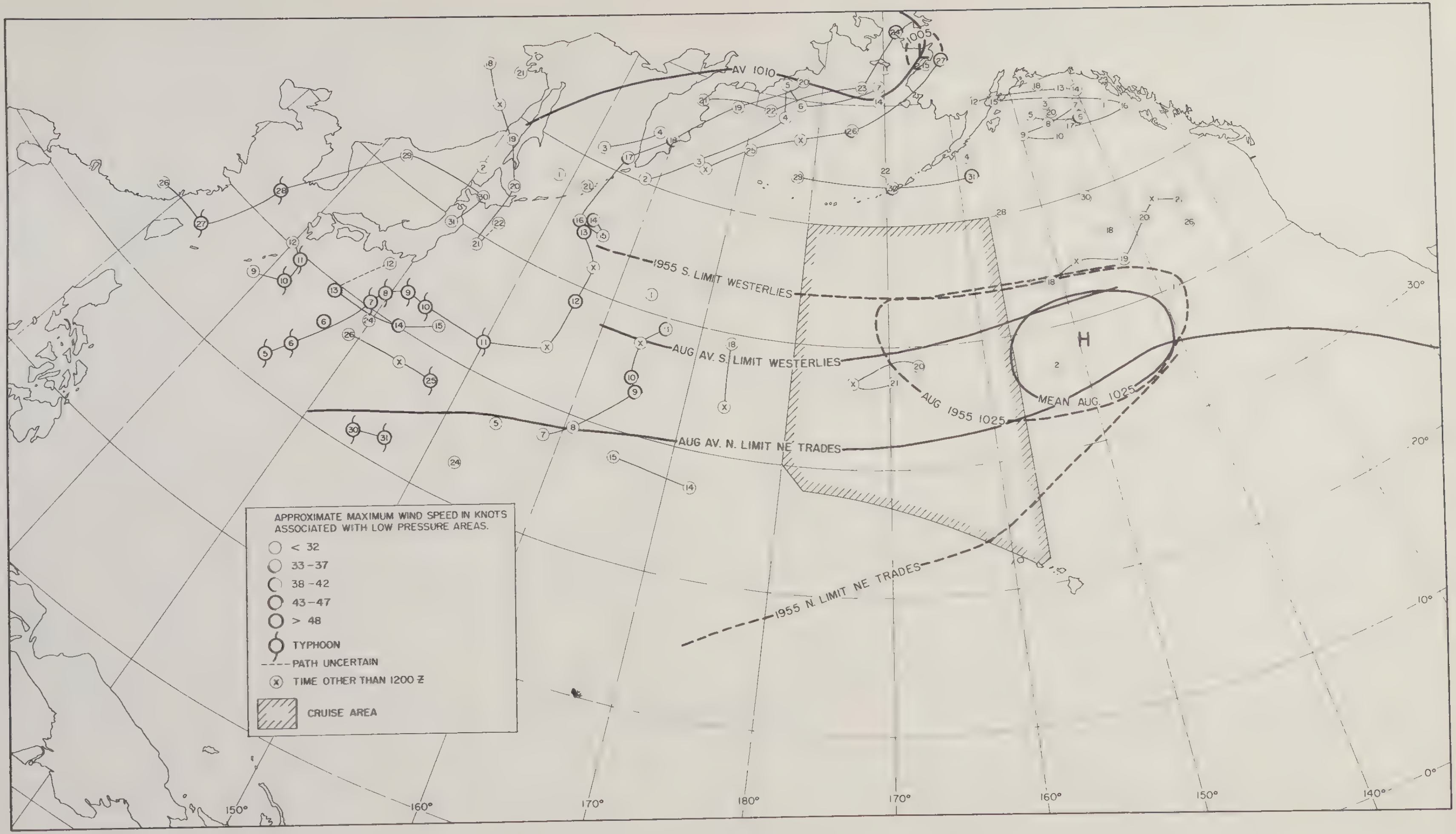

AV 1010
1005
1955 S. LIMIT WESTERLIES
AUG AV. S. LIMIT WESTERLIES
H
MEAN AUG. 1025
AUG 1955 1025
AUG AV. N. LIMIT NE TRADES
1955 N. LIMIT NE TRADES
APPROXIMATE MAXIMUM WIND SPEED IN KNOTS ASSOCIATED WITH LOW PRESSURE AREAS.
< 32
33 - 37
38 - 42
43 - 47
> 48
TYPHOON
PATH UNCERTAIN
TIME OTHER THAN 1200 Z
CRUISE AREA
30°
20°
10°
0°
150°
160°
170°
180°
170°
160°
150°
140°

Figure 144.--Normal (heavy solid lines) and mean August 1955 (broken lines) position of the Eastern North Pacific High; normal and 1955 mean monthly limits of the northeast trades and westerlies; tracks of centers of low pressure areas showing daily positions.

NOTES ON TABLE 1, TABULATED OCEANOGRAPHIC DATA, CHG 17

Where more than one cast was made on a station, they are divided in the observed data by a horizontal line, and the cast number indicated by Roman numerals.

Weather is recorded in the ww (present weather) code given in the U. S. Weather Bureau circular M, eighth edition, Manual of Marine Meteorological Observations. Cloud cover is in tenths of the sky.

Wind velocity was measured with an anemometer approximately 8 meters above the sea surface. The direction (given to the nearest 10°) is that from which the wind was blowing, measured through 360° from north.

The following abbreviations, when appended to values or lines in the tabulated data have the following meanings:

Q -- The value seems questionable, but was used in construction of the station curve.

P -- The value is poor, and while carried was not used in drawing the station curve.

NG -- The value is obviously in error, and was dropped from the tabulations.

Table 1.--Oceanographic station data

STATION 1

M/V Charles H. Gilbert: Cruise 17, 22°30'N., 159°58'W., September 19, 1954. Messenger time: 0245 GCT. Weather 02, cloud coverage 4. Wind: 070°, 16 kt. Sea: 5-8 ft. Wire angle: 35°. BT slide: 2

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	26.58	35.07	22.93	4.25	- *
22	26.58	35.08	22.93	3.97	-
43	25.98	35.12	23.15	3.69	-
86	22.66	35.25	24.24	3.89	-
129	20.96	35.30	24.75	3.85	-
172	19.67	35.21	25.03	2.21 a/	-
263	14.21	34.45	25.74	3.02	-
349	10.42	34.20	26.27	3.91	-
445	08.57	34.13	26.52	3.98	-
528	06.94	34.09	26.73	4.35	-
724	05.17	34.27	27.10	0.98	-
921	04.58	34.43	27.29	1.62	-
1115	03.96	34.51	27.42	NS	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	26.58	35.07	22.93	0.000	1.878
10	26.58	35.07	22.93	0.049	1.829
20	26.58	35.08	22.93	0.099	1.779
30	26.52	35.08	22.95	0.148	1.730
50	24.70	35.18	23.59	0.241	1.637
75	23.65	35.21	23.92	0.345	1.533
100	21.93	35.28	24.47	0.440	1.438
150	20.40	35.28	24.89	0.605	1.273
200	17.85	34.95	25.29	0.753	1.125
250	14.60	34.49	25.68	0.881	0.997
300	12.40	34.29	25.98	0.993	0.885
400	09.42	34.16	26.41	1.184	0.694
500	07.38	34.09	26.67	1.342	0.536
600	06.08	34.14	26.89	1.478	0.400
700	05.29	34.24	27.06	1.595	0.283
800	04.88	34.34	27.19	1.698	0.180
1000	04.31	34.47	27.35	1.878	0.000

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* Due to malfunctioning colorimeter, PO_4-P samples could not be analyzed.

Table 1.--Oceanographic station data (cont'd)

STATION 2

M/V Charles H. Gilbert: Cruise 17, 24°12'N., 159°59'W., September 19, 1954. Messenger time: first cast 1806 GCT, second cast 1844 GCT. Weather: 02, cloud coverage 3. Wind: 090°, 16 kt. Sea: 1-3 ft. Wire angle: first cast 18°, second cast 19°. BT slide: 6

OBSERVED

	DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
	0	25.64	35.26	23.36	4.30	- *
	20	25.64	35.26	23.36	4.38	-
I	58	23.68	35.41	24.06	4.96	-
	96	21.78	NS	-	4.85	-
	145	19.82	35.19	24.97	4.53	-
	193	18.20	35.01	25.25	4.23	-
	389	11.36	34.23	26.13	4.37	-
	489	08.42	34.13	26.55	3.60	-
	596	06.20	34.09	26.83	2.22	-
II	688	05.50	34.25	27.04	0.98	-
	907	04.39	34.43	27.31	0.91	-
	1115	03.78	34.52	27.45	1.14	-
	PT	-	-	-	-	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	25.64	35.26	23.36	0.000	1.898
10	25.64	35.26	23.36	0.045	1.853
20	25.64	35.26	23.36	0.091	1.807
30	25.64	35.26	23.36	0.136	1.762
50	25.64	35.26	23.36	0.227	1.671
75	22.64	35.36	24.33	0.329	1.569
100	21.56	35.32	24.60	0.417	1.481
150	19.55	35.16	25.02	0.576	1.322
200	18.00	34.97	25.27	0.721	1.177
250	15.28	34.56	25.59	0.852	1.046
300	13.42	34.36	25.83	0.971	0.927
400	11.08	34.22	26.17	1.180	0.718
500	08.17	34.11	26.57	1.355	0.543
600	06.16	34.10	26.84	1.498	0.400
700	05.42	34.26	27.06	1.618	0.280
800	04.88	34.34	27.19	1.721	0.177
1000	04.06	34.47	27.38	1.898	0.000

---

* Due to malfunctioning colorimeter, PO_4-P samples could not be analyzed.

Table 1.--Oceanographic station data (cont'd)

STATION 3

M/V Charles H. Gilbert: Cruise 17, 25°35'N., 159°52'W., September 20, 1954. Messenger time: 0736 GCT. Weather: 02, cloud coverage 1. Wind: 040°, 8 kt. Sea: 1-3 ft. Wire angle: 25°. BT slide: 9

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	25.14	35.53	23.72	4.94	0.23
23	NG	35.57	-	4.92	0.24
41	25.00	35.57	23.79	4.67	0.24
78	21.92	35.39	24.56	5.22	0.23
138	19.15	35.17	25.13	4.80	0.27
203	16.58	34.74	25.43	4.50	0.52
305	13.14	34.34	25.87	3.97	0.72
412	10.44	34.18	26.26	4.44	1.01
480	08.52	34.09	26.50	3.50	1.54
514	-	-	-	-	-
616	06.23	34.04	26.79	2.46	2.18
818	04.63	34.23	27.13	0.62	2.59
1024	03.80	34.42	27.37	1.05	2.74
1220	03.29	34.51	27.49	1.22	2.81

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	25.14	35.53	23.72	0.000	1.876
10	25.10	35.55	23.75	0.042	1.834
20	25.08	35.56	23.76	0.083	1.793
30	25.05	35.56	23.77	0.125	1.751
50	24.90	35.57	23.82	0.207	1.669
75	21.95	35.39	24.55	0.302	1.574
100	20.70	35.31	24.83	0.384	1.492
150	18.77	35.12	25.19	0.534	1.342
200	16.80	34.77	25.40	0.671	1.205
250	14.61	34.48	25.67	0.797	1.079
300	13.28	34.35	25.85	0.913	0.963
400	10.82	34.21	26.21	1.120	0.756
500	08.42	34.08	26.51	1.296	0.580
600	06.47	34.04	26.76	1.446	0.430
700	05.41	34.11	26.94	1.575	0.301
800	04.78	34.22	27.10	1.688	0.188
1000	03.88	34.40	27.34	1.876	0.000

Table 1. --Oceanographic station data (cont'd)

STATION 4

M/V Charles H. Gilbert: Cruise 17, 27°00'N., 160°00'W., September 20, 1954. Messenger time: 2015 GCT. Weather: 02, cloud coverage 5. Wind: 040°, 10 kt. Sea: 1-3 ft. Wire angle: 15°. BT slide: 14

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	25.53	35.34	23.45	4.65	0.31
25	25.50	35.34	23.46	4.66	0.33
56	25.49	35.35	23.47	4.56	0.28
86	23.30	35.35	24.13	4.43	0.31
132	21.71	35.37	24.60	4.26	0.25
222	17.87	34.96	25.29	4.14	0.38
333	13.04	34.36	25.90	4.62	0.72
449	09.76	34.14	26.34	4.33	1.32
560	08.01	34.09	26.58	3.64	1.61
671	06.12	34.07	26.82	2.30	2.31
888	04.38	34.31	27.22	0.98	2.68
1105	03.68	34.43	27.39	1.08	2.53
1311	03.28	34.51	27.49	1.31	2.82

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	25.53	35.34	23.46	0.000	2.004
10	25.53	35.34	23.46	0.044	1.960
20	25.53	35.34	23.46	0.089	1.915
30	25.52	35.34	23.46	0.133	1.871
50	25.49	35.35	23.48	0.222	1.782
75	23.80	35.35	23.99	0.327	1.677
100	22.70	35.36	24.31	0.422	1.582
150	20.82	35.32	24.81	0.594	1.410
200	18.82	35.10	25.16	0.746	1.258
250	16.50	34.74	25.45	0.884	1.120
300	14.33	34.48	25.73	1.008	0.996
400	10.82	34.20	26.20	1.221	0.783
500	08.90	34.11	26.46	1.400	0.604
600	07.37	34.07	26.66	1.558	0.446
700	05.75	34.09	26.89	1.695	0.309
800	04.83	34.21	27.09	1.812	0.192
1000	03.99	34.38	27.32	2.004	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 5

M/V *Charles H. Gilbert*: Cruise 17, 28°28'N., 159°59'W., September 21, 1954. Messenger time: 0937 GCT. Weather: 02, cloud coverage not recorded. Wind: 100°, 10 kt. Sea: 1-3 ft. Wire angle: 06°. BT slide: 17

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	25.04	35.55	23.76	4.77	0.22
27	24.98	35.52	23.76	4.84	0.21
57	22.76	35.30	24.25	5.06	0.21
116	18.08	34.92	25.21	5.12	0.24
173	15.59	34.58	25.54	4.92	0.39
230	13.46	34.43	25.88	4.65	0.68
346	10.99	34.22	26.19	4.80	0.99
463	08.69	NG	-	NG	NG
580	06.53	34.05	26.75	3.29	1.87
694	05.22	34.09	26.95	1.83	2.51
919	04.07	34.31	27.25	0.91	2.68
1136	03.56	34.45	27.45	0.74	2.71
1346	03.06	34.54	27.53	1.13	2.88

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	25.04	35.55	23.77	0.000	1.780
10	25.02	35.54	23.76	0.041	1.739
20	25.00	35.52	23.75	0.083	1.697
30	24.95	35.52	23.77	0.125	1.655
50	24.89	35.51	23.78	0.208	1.572
75	19.70	35.08	24.92	0.298	1.482
100	18.66	34.98	25.11	0.372	1.408
150	16.42	34.68	25.42	0.510	1.270
200	14.66	34.51	25.69	0.634	1.146
250	12.88	34.37	25.95	0.747	1.033
300	11.81	34.28	26.09	0.850	0.930
400	09.96	34.16	26.32	1.040	0.740
500	08.00	34.08	26.57	1.208	0.572
600	06.20	34.04	26.79	1.353	0.427
700	05.20	34.09	26.95	1.479	0.301
800	04.59	34.19	27.10	1.591	0.189
1000	03.81	34.37	27.33	1.780	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 6

M/V Charles H. Gilbert: Cruise 17, 30°03'N., 159°49'W., September 21, 1954. Messenger time: 2100 GCT. Weather: 02, cloud coverage 1. Wind: Calm. Sea: <1 ft. Wire angle: 07°. BT slide: 21

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	24.82	35.57	23.85	4.46	0.02
26	24.47	35.57	23.95	4.51	0.01
57	22.00	35.17	24.36	4.97	0.09
114	17.26	34.74	25.26	5.36	0.13
172	15.21	34.52	25.58	4.72	0.35
226	13.60	34.40	25.82	4.42	0.59
343	11.12	34.22	26.17	4.31	0.83
463	08.71	NG	-	NG	NG
576	06.58	34.02	26.73	3.38	1.52
693	05.00	34.07	26.96	1.81	2.21
915	03.86	34.25	27.23	0.95	2.03
1134	03.35	34.43	27.42	0.70	2.13
1345	03.07	34.40	27.42	0.92	1.99

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.82	35.57	23.85	0.000	1.769
10	24.58	35.57	23.92	0.040	1.729
20	24.50	35.57	23.94	0.080	1.689
30	24.45	35.57	23.96	0.120	1.649
50	23.68	35.45	24.10	0.198	1.571
75	19.70	34.97	24.84	0.286	1.483
100	17.69	34.78	25.20	0.360	1.409
150	16.18	34.62	25.43	0.495	1.274
200	14.19	34.45	25.74	0.618	1.151
250	13.12	34.37	25.90	0.731	1.038
300	12.05	34.29	26.05	0.836	0.933
400	10.00	34.16	26.32	1.028	0.741
500	08.00	34.07	26.56	1.196	0.573
600	06.20	34.02	26.78	1.342	0.427
700	04.96	34.07	26.97	1.469	0.300
800	04.38	34.15	27.09	1.581	0.188
1000	03.60	34.35	27.33	1.769	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 7

M/V Charles H. Gilbert: Cruise 17, 31°29'N., 159°50'W., September 22, 1954. Messenger time: 1008 GCT. Weather: 02, clear. Wind: calm. Sea: <1 ft. Wire angle: 05°. BT slide: 26

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σt	O_2 (ml/l)	PO_4-P (μg at/l)
0	24.38	34.85	23.44	4.71	0.01
16	24.12	34.87	23.53	4.41	0.07
32	19.60	34.61	24.59	5.36	0.13
69	15.89	34.52	25.42	5.76	0.16
141	14.04	34.43	25.75	4.65	0.61
217	13.00	34.38	25.93	4.55	0.68
321	11.36	34.29	26.18	4.39	0.88
431	09.76	NG	-	NG	NG
538	07.81	34.05	26.58	3.82	1.49
649	05.98	34.04	26.82	2.98	1.88
866	04.12	34.16	26.13	1.02	2.20
1075	03.54	34.34	27.33	0.58	2.27
1289	03.05	34.43	27.45	0.86	2.56

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σt	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.38	34.85	23.44	0.000	1.726
10	24.21	34.86	23.49	0.044	1.682
20	24.02	34.87	23.56	0.088	1.638
30	23.60	34.84	23.66	0.131	1.595
50	16.90	34.55	25.21	0.201	1.525
75	15.64	34.51	25.47	0.268	1.458
100	14.82	34.47	25.62	0.330	1.396
150	13.99	34.42	25.76	0.447	1.279
200	13.24	34.39	25.89	0.558	1.168
250	12.48	34.35	26.01	0.664	1.062
300	11.68	34.31	26.13	0.765	0.961
400	10.22	34.22	26.33	0.953	0.773
500	08.52	34.10	26.51	1.123	0.603
600	06.66	34.04	26.73	1.275	0.451
700	05.40	34.05	26.90	1.407	0.319
800	04.57	34.10	27.03	1.525	0.201
1000	03.72	34.28	27.26	1.726	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 8

M/V Charles H. Gilbert: Cruise 17, 32°57'N., 159°55'W., September 22, 1954. Messenger time: 2143 GCT. Weather: 02, cloud coverage 1. Wind: 300°, 6 kt. Sea: <1 ft. Wire angle: 00°. BT slide: 29

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	23.64	34.74	23.57	4.45	0.22
21	24.18	35.10	23.68	4.26	0.14
42	18.85	34.58	24.76	5.18	0.20
83	15.62	34.49	25.46	5.24	0.21
151	13.48	34.40	25.85	4.70	0.60
214	12.30	34.34	26.04	4.61	0.81
319	10.99	34.25	26.22	4.44	0.95
431	09.11	NG	-	NG	NG
537	07.26	34.04	26.65	3.60	1.69
648	05.54	33.98	26.82	2.58	2.14
864	04.08	34.16	27.13	0.79	2.31
1073	03.39	34.34	27.34	0.60	2.14
1286	02.99	34.45	27.47	0.24	2.71

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.64	34.74	23.57	0.000	1.684
10	23.90	34.86	23.59	0.043	1.641
20	24.17	35.09	23.68	0.086	1.598
30	24.10	35.10	23.71	0.128	1.556
50	17.63	34.55	25.04	0.200	1.484
75	16.10	34.51	25.37	0.270	1.414
100	14.85	34.47	25.62	0.333	1.351
150	13.50	34.40	25.85	0.448	1.236
200	12.55	34.35	26.00	0.555	1.129
250	11.77	34.31	26.12	0.656	1.028
300	11.19	34.27	26.19	0.752	0.932
400	09.67	34.17	26.38	0.934	0.750
500	07.88	34.07	26.58	1.098	0.586
600	06.20	33.99	26.75	1.245	0.439
700	05.01	34.02	26.92	1.375	0.309
800	04.35	34.12	27.07	1.489	0.195
1000	03.60	34.29	27.28	1.684	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 9

M/V Charles H. Gilbert: Cruise 17, 34°29'N., 160°08'W., September 23, 1954. Messenger time: 1018 GCT. Weather: 02, clear. Wind: 240°, 18 kt. Sea: 3-5 ft. Wire angle: 31°. BT slide: 33

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
4	23.60	34.69	23.55	4.31	0.28
21	23.60	34.69	23.55	4.49	0.22
46	21.20	34.58	24.14	5.58	0.20
81	14.80	34.42	25.59	6.12	0.24
145	12.72	34.36	25.97	5.11	0.59
206	11.92	34.31	26.09	5.24	0.71
311	10.26	34.18	26.29	5.42	0.88
420	08.95	34.14	26.47	4.76	1.17
525	07.33	34.05	26.64	4.02	1.68
631	05.48	34.02	26.86	2.80	2.09
838	04.06	34.20	27.17	0.98	2.52
1047	03.31	34.36	27.37	0.45	2.46
1251	02.91	34.43	27.46	0.30	2.67

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	23.60	34.69	23.55	0.000	1.642
10	23.60	34.69	23.55	0.044	1.598
20	23.60	34.69	23.55	0.087	1.555
30	23.60	34.69	23.55	0.131	1.511
50	19.80	34.55	24.49	0.209	1.433
75	15.10	34.43	25.53	0.284	1.358
100	14.00	34.40	25.74	0.343	1.299
150	12.61	34.35	25.99	0.452	1.190
200	11.98	34.32	26.08	0.553	1.089
250	11.30	34.26	26.16	0.651	0.991
300	10.48	34.20	26.26	0.745	0.897
400	09.18	34.15	26.44	0.920	0.722
500	07.73	34.07	26.60	1.079	0.563
600	06.00	34.01	26.79	1.222	0.420
700	04.82	34.08	26.99	1.347	0.295
800	04.25	34.16	27.11	1.456	0.186
1000	03.44	34.33	27.33	1.642	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 10

M/V Charles H. Gilbert: Cruise 17, 38°54'N., 160°07'W., September 24, 1954. Messenger time: 2206 GCT. Weather: 60, cloud coverage 9. Wind: 060°, 10 kt. Sea: 1-3 ft. Wire angle: 06°. BT slide: 43

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	22.22	34.14	23.52	5.45	0.21
15	22.22	34.16	23.54	5.28	0.20
31	18.23	34.14	24.58	6.80	0.16
57	12.50	34.23	25.92	5.67	0.57
110	11.44	34.20	26.09	5.65	0.70
165	10.82	34.22	26.22	5.42	0.86
227	10.16	34.18	26.31	4.04	0.92
340	08.94	34.14	26.47	3.09	1.15
457	07.22	34.04	26.65	3.09	1.60
572	05.54	34.02	26.86	2.96	2.03
681	04.65	34.09	27.02	1.76	2.31
903	03.81	34.23	27.21	0.73	2.49
1126	03.17	34.36	27.38	0.33	2.84

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	22.22	34.14	23.52	0.000	1.499
10	22.22	34.15	23.53	0.044	1.455
20	22.22	34.16	23.54	0.087	1.412
30	19.80	34.14	24.18	0.128	1.371
50	13.20	34.22	25.77	0.188	1.311
75	11.98	34.23	26.01	0.241	1.258
100	11.60	34.20	26.06	0.291	1.208
150	11.00	34.22	26.19	0.388	1.111
200	10.45	34.20	26.27	0.480	1.019
250	09.88	34.18	26.35	0.568	0.931
300	09.39	34.16	26.42	0.653	0.846
400	08.10	34.10	26.57	0.814	0.685
500	06.55	34.02	26.73	0.961	0.538
600	05.23	34.04	26.91	1.091	0.408
700	04.55	34.12	27.05	1.207	0.292
800	04.15	34.18	27.14	1.311	0.188
1000	03.52	34.29	27.29	1.499	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 11

M/V Charles H. Gilbert: Cruise 17, 42°07'N., 159°59'W., September 26, 1954. Messenger time: 2356 GCT. Weather: 02, cloud coverage 4. Wind: 340°, 15 kt. Sea: 1-3 ft. Wire angle: 35°. BT slide: 49

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.00	33.75	24.09	5.50	0.27
17	18.95	33.75	24.10	5.16	0.27
31	18.82	33.78	24.16	5.24	0.28
60	11.87	33.78	25.68	6.74	0.57
94	09.85	33.89	26.13	6.25	0.84
137	08.92	33.93	26.31	6.05	0.98
188	08.70	34.04	26.43	5.68	1.07
283	07.70	34.00	26.55	5.24	1.15
385	06.28	34.00	26.75	4.36	1.55
480	05.18	34.07	26.94	2.72	2.13
579	04.59	NG	-	NG	NG
774	03.84	34.20	27.19	0.88	2.53
979	03.27	34.33	27.35	0.55	2.86

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	19.00	33.75	24.09	0.000	1.360
10	18.98	33.75	24.09	0.038	1.322
20	18.90	33.76	24.12	0.077	1.283
30	18.83	33.77	24.15	0.115	1.245
50	12.38	33.78	25.59	0.177	1.183
75	10.65	33.84	25.96	0.233	1.127
100	09.64	33.90	26.17	0.282	1.078
150	08.81	33.96	26.36	0.372	0.988
200	08.65	34.04	26.44	0.455	0.905
250	08.08	34.02	26.51	0.535	0.825
300	07.47	34.00	26.59	0.612	0.748
400	06.08	34.01	26.78	0.754	0.606
500	04.99	34.08	26.97	0.877	0.483
600	04.47	34.13	27.07	0.988	0.372
700	04.07	34.17	27.14	1.091	0.269
800	03.78	34.22	27.21	1.187	0.173
1000	03.23	34.34	27.36	1.360	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 12

M/V Charles H. Gilbert: Cruise 17, 43°42'N., 160°00'W., September 27, 1954. Messenger time: 1331 GCT. Weather: 02, clear. Wind: 100°, 14 kt. Sea: 1-3 ft. Wire angle: 03°. BT slide: 53

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.17	33.95	24.20	5.34	0.39
21	19.18	33.98	24.21	5.37	0.42
44	18.01	33.89	24.45	5.78	0.42
73	10.45	33.86	26.01	6.23	0.89
108	08.87	33.80	26.22	6.16	1.02
165	08.59	34.00	26.42	6.05	1.07
251	08.01	34.04	26.54	5.46	1.34
376	06.38	34.02	26.75	4.05	1.89
495	05.03	34.00	26.90	2.60	2.27
622	04.33	34.09	27.05	1.51	2.60
739	03.89	34.22	27.20	0.97	2.62
983	03.28	34.34	27.35	0.56	2.79
1215	02.87	34.42	27.45	0.41	2.91

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	19.17	33.95	24.20	0.000	1.350
10	19.17	33.96	24.20	0.037	1.313
20	19.18	33.98	24.22	0.075	1.275
30	19.15	33.98	24.22	0.112	1.238
50	12.60	33.87	25.62	0.173	1.177
75	10.40	33.86	26.01	0.228	1.122
100	08.95	33.80	26.21	0.276	1.074
150	08.67	33.96	26.38	0.364	0.986
200	08.38	34.03	26.48	0.446	0.904
250	08.02	34.04	26.54	0.525	0.825
300	07.57	34.04	26.60	0.601	0.749
400	06.01	34.01	26.79	0.741	0.609
500	05.00	34.00	26.91	0.868	0.482
600	04.43	34.06	27.02	0.984	0.366
700	04.00	34.18	27.16	1.088	0.262
800	03.70	34.26	27.25	1.182	0.168
1000	03.25	34.35	27.37	1.350	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 13

M/V Charles H. Gilbert: Cruise 17, 45°03'N., 163°43'W., October 1, 1954. Messenger time: 1926 GCT. Weather: 50, cloud coverage 8. Wind: 180°, 18 kt. Sea: 5-8 ft. Wire angle: 35°. BT slide: 65

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	15.53	33.06	24.39	6.11	0.69
13	15.51	33.12	24.44	6.38	0.77
27	15.51	33.08	24.41	6.68	0.75
44	08.69	33.37	25.91	7.04	1.07
84	06.80	33.40	26.21	6.72	1.20
142	06.39	33.57	26.39	6.29	1.18
214	06.33	33.86	26.63	5.45	1.34
321	05.38	33.87	26.76	3.73	1.99
424	04.69	33.98	26.92	2.35	2.20
532	04.27	34.05	27.02	1.68	2.51
637	03.90	34.13	27.13	1.05	2.60
856	03.40	34.27	27.29	0.68	2.41
NG	-	-	-	-	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	15.53	33.06	24.38	0.000	1.238
10	15.52	33.10	24.42	0.035	1.203
20	15.51	33.10	24.42	0.071	1.167
30	13.40	33.30	25.02	0.103	1.135
50	08.20	33.37	25.99	0.153	1.085
75	07.05	33.39	26.17	0.202	1.036
100	06.59	33.84	26.58	0.244	0.994
150	06.39	33.87	26.63	0.316	0.922
200	06.35	33.87	26.64	0.388	0.850
250	06.00	33.86	26.67	0.459	0.779
300	05.53	33.86	26.73	0.529	0.709
400	04.81	33.96	26.89	0.657	0.581
500	04.40	34.03	27.00	0.773	0.465
600	04.00	34.10	27.09	0.880	0.358
700	03.72	34.17	27.18	0.980	0.258
800	03.53	34.24	27.25	1.072	0.166
1000	03.15	34.36	27.38	1.238	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 14

M/V Charles H. Gilbert: Cruise 17, 43°47'N., 169°43'W., October 4, 1954. Messenger time: 0531 GCT. Weather: 02, cloud coverage 8. Wind: 330°, 3 kt. Sea: 3-5 ft. Wire angle: 18°. BT slide: 77

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	14.04	33.33	24.91	6.05	0.50
20	14.00	33.33	24.92	6.20	0.52
35	09.52	33.66	26.01	6.08	0.75
56	08.64	33.71	26.18	5.20	0.81
85	07.79	33.75	26.35	3.86	0.96
149	07.67	33.89	26.47	3.17	0.99
217	06.62	33.89	26.62	2.99	1.24
326	05.48	33.93	26.79	2.56	1.82
441	04.67	34.02	26.96	2.38	2.10
550	04.28	34.11	27.07	1.70	2.31
661	03.90	34.18	27.17	1.13	2.38
873	03.35	34.31	27.32	0.71	2.54
1089	02.95	34.42	27.45	0.55	2.65

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	14.04	33.33	24.91	0.000	1.229
10	14.02	33.33	24.91	0.031	1.198
20	14.00	33.33	24.92	0.061	1.168
30	13.99	33.34	24.93	0.091	1.138
50	09.00	33.69	26.11	0.141	1.088
75	07.92	33.73	26.31	0.187	1.042
100	07.77	33.76	26.36	0.230	0.999
150	07.66	33.89	26.47	0.312	0.917
200	06.84	33.90	26.60	0.388	0.841
250	06.21	33.90	26.68	0.461	0.768
300	05.72	33.91	26.75	0.529	0.700
400	04.91	33.98	26.90	0.656	0.573
500	04.46	34.06	27.01	0.772	0.457
600	04.08	34.14	27.12	0.877	0.352
700	03.79	34.20	27.19	0.975	0.254
800	03.52	34.25	27.26	1.066	0.163
1000	03.06	34.38	27.41	1.229	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 15

M/V Charles H. Gilbert: Cruise 17, 42°14'N., 169°53'W., October 4, 1954. Messenger time: 1834 GCT. Weather: 50, cloud coverage 8. Wind: 140°, 13 kt. Sea: 1-3 ft. Wire angle: 26°. BT slide: 80

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	15.16	33.48	24.79	5.40	0.66
18	15.16	33.49	24.80	5.49	0.67
32	11.42	33.98	25.92	6.30	0.94
50	10.33	34.02	26.15	5.80	1.30
77	09.53	34.02	26.28	5.84	1.39
137	09.12	34.11	26.42	5.60	1.26
201 *	08.12	34.02	26.51	5.37	1.45
303	06.84	33.96	26.64	4.61	1.68
409	05.48	33.95	26.81	3.70	2.15
511	04.76	34.00	26.93	2.21	2.63
614	04.28	34.13	27.09	1.49	2.71
820	03.62	34.27	27.27	0.82	2.65
1032	02.92	34.38	27.42	0.63	2.77

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	15.16	33.48	24.79	0.000	1.281
10	15.16	33.49	24.79	0.032	1.249
20	15.18	33.54	24.83	0.063	1.218
30	15.15	33.72	24.97	0.094	1.187
50	10.33	34.02	26.15	0.143	1.138
75	09.55	34.02	26.28	0.188	1.093
100	09.30	34.09	26.38	0.231	1.050
150	08.99	34.11	26.44	0.314	0.967
200	08.14	34.02	26.50	0.394	0.887
250	07.50	33.99	26.58	0.471	0.810
300	06.90	33.96	26.64	0.545	0.736
400	05.58	33.95	26.80	0.683	0.598
500	04.81	33.99	26.92	0.808	0.473
600	04.32	34.11	27.07	0.921	0.360
700	04.00	34.19	27.16	1.022	0.259
800	03.72	34.25	27.24	1.116	0.165
1000	03.00	34.37	27.40	1.281	0.000

* This bottle flipped almost upright by a heavy roll as it broke the surface, but data look good.

Table 1.--Oceanographic station data (cont'd)

STATION 16

M/V Charles H. Gilbert: Cruise 17, 41°00'N., 169°47'W., October 5, 1954. Messenger time: 0726 GCT. Weather: 02, cloud coverage not recorded. Wind: 210°, 22 kt. Sea: 3-5 ft. Wire angle: 26°. BT slide: 83

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 * (ml/l)	PO_4-P (µg at/l)
0	16.53	33.95	24.84	5.02	0.33
19	16.52	33.93	24.83	5.09	0.35
42	15.92	33.86	24.91	5.48	0.38
54	11.33	34.13	26.06	5.76	0.81
108	09.86	34.09	26.29	5.76	1.00
162	09.52	34.14	26.38	5.61	1.06
218	08.89	34.11	26.46	5.40	1.14
327	07.51	34.02	26.60	4.94	1.54
436	05.82	33.96	26.78	3.46	1.90
551	04.81	34.02	26.94	2.61	2.40
658	04.40	34.11	27.06	1.91	2.64
882	03.64	34.25	27.25	0.88	2.74
1112	03.08	34.38	27.40	0.57	2.95

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	16.53	33.95	24.84	0.000	1.355
10	16.53	33.94	24.83	0.031	1.324
20	16.52	33.93	24.83	0.063	1.292
30	16.25	33.89	24.86	0.094	1.261
50	11.41	34.11	26.03	0.145	1.210
75	10.83	34.13	26.15	0.194	1.161
100	10.20	34.09	26.23	0.240	1.115
150	09.82	34.10	26.30	0.330	1.025
200	09.03	34.12	26.45	0.414	0.941
250	08.51	34.09	26.50	0.495	0.860
300	07.87	34.04	26.56	0.573	0.782
400	06.30	33.96	26.71	0.719	0.636
500	05.20	33.98	26.87	0.851	0.504
600	04.60	34.07	27.01	0.969	0.386
700	04.22	34.14	27.10	1.077	0.278
800	03.90	34.21	27.19	1.177	0.178
1000	03.34	34.31	27.33	1.355	0.000

* Order of O_2 samples is unsure, but appears correct.

Table 1.--Oceanographic station data (cont'd)

STATION 17

M/V Charles H. Gilbert: Cruise 17, 38°41'N., 169°57'W., October 6, 1954. Messenger time: 0708 GCT. Weather: 02, clear. Wind: 200°, 05 kt. Sea: 1-3 ft. Wire angle: 12°. BT slide: 88

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	18.12	33.78	24.33	5.24	0.34
26	18.10	33.77	24.33	5.61	0.44
45	14.44	34.31	25.58	6.36	0.56
65	13.10	34.36	25.90	5.74	0.63
118	12.03	34.31	26.07	5.34	0.92
166	10.99	34.22	26.19	5.29	0.96
230	10.12	34.20	26.33	5.03	1.06
354	07.96	34.04	26.55	5.01	1.38
466	06.27	33.95	26.71	4.17	1.79
585	05.00	33.98	26.89	2.65	2.32
698	04.37	34.09	27.05	1.80	2.67
928	03.64	34.25	27.25	0.80	2.66
1162	03.05	34.36	27.39	0.58	2.73

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	18.12	33.78	24.33	0.000	1.469
10	18.12	33.78	24.33	0.036	1.433
20	18.11	33.77	24.32	0.072	1.397
30	18.10	33.77	24.33	0.108	1.361
50	13.93	34.35	25.72	0.168	1.301
75	12.86	34.34	25.93	0.223	1.246
100	12.42	34.33	26.01	0.274	1.195
150	11.25	34.24	26.16	0.373	1.096
200	10.50	34.21	26.27	0.465	1.004
250	09.81	34.17	26.36	0.553	0.916
300	08.96	34.10	26.44	0.638	0.831
400	07.20	33.99	26.62	0.795	0.674
500	05.82	33.95	26.77	0.937	0.532
600	04.88	33.99	26.91	1.065	0.404
700	04.33	34.10	27.06	1.180	0.289
800	03.99	34.17	27.15	1.283	0.186
1000	03.44	34.29	27.30	1.469	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 18

M/V Charles H. Gilbert: Cruise 17, 37°07'N., 170°05'W., October 7, 1954. Messenger time: 0528 GCT. Weather: 28, cloud coverage 9. Wind: calm. Sea: <1 ft. Wire angle: 03°. BT slide: 91

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	20.22	34.05	24.00	4.83	0.35
15	19.42	34.07	24.22	4.94	0.30
31	19.40	34.07	24.23	4.79	0.26
54	14.64	34.45	25.64	5.47	0.38
75	13.64	34.43	25.84	4.90	0.71
149	12.48	34.40	26.05	4.92	0.76
237	11.24	34.31	26.21	4.55	0.93
365	09.01	34.13	26.45	4.90	1.30
483	07.16	34.00	26.63	4.45	1.59
605	05.45	33.98	26.84	3.03	2.23
728	04.56	34.07	27.01	1.91	2.57
971	03.69	34.23	27.23	0.75	2.65
1209	03.03	34.36	27.39	0.41	2.83

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	20.22	34.05	24.00	0.000	1.561
10	19.52	34.06	24.19	0.038	1.523
20	19.41	34.07	24.23	0.076	1.485
30	19.40	34.07	24.23	0.113	1.448
50	15.20	34.44	25.52	0.175	1.386
75	13.64	34.43	25.84	0.233	1.328
100	13.12	34.42	25.94	0.287	1.274
150	12.47	34.40	26.05	0.389	1.172
200	11.80	34.36	26.15	0.488	1.073
250	11.00	34.29	26.24	0.582	0.979
300	10.19	34.23	26.34	0.672	0.889
400	08.48	34.08	26.50	0.840	0.721
500	06.87	33.99	26.66	0.994	0.567
600	05.50	33.98	26.83	1.132	0.429
700	04.70	34.05	26.98	1.254	0.307
800	04.22	34.12	27.09	1.365	0.196
1000	03.60	34.25	27.25	1.561	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 19

M/V *Charles H. Gilbert*: Cruise 17, 34°07'N., 170°12'W., October 8, 1954. Messenger time: 0629 GCT. Weather: 02, cloud coverage 3. Wind: 190°, 19 kt. Sea: 3-5 ft. Wire angle: 22°. BT slide: 97

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
4	22.35	34.42	23.70	4.22	- *
22	22.22	34.52	23.81	4.12	-
46	18.76	34.69	24.86	4.79	-
59	17.50	34.69	25.18	4.64	-
89	16.04	34.67	25.50	4.41	-
147	14.89	34.60	25.71	4.31	-
232	13.42	34.47	25.92	4.15	-
353	11.14	34.31	26.23	4.38	-
461	09.09	34.13	26.44	4.57	-
579	07.02	34.04	26.68	3.80	-
686	05.27	34.00	26.87	2.86	-
913	04.02	34.20	27.17	1.08	-
1141	03.02	34.34	27.38	0.56	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t (gm/l)	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	22.35	34.42	23.70	0.000	1.738
10	22.35	34.44	23.72	0.042	1.696
20	22.27	34.46	23.75	0.084	1.654
30	21.80	34.61	24.00	0.124	1.614
50	18.25	34.70	25.00	0.193	1.545
75	16.60	34.68	25.38	0.264	1.474
100	15.78	34.66	25.55	0.327	1.411
150	14.82	34.60	25.72	0.447	1.291
200	14.01	34.52	25.83	0.561	1.177
250	13.12	34.45	25.96	0.670	1.068
300	12.20	34.37	26.08	0.773	0.965
400	10.22	34.22	26.33	0.963	0.775
500	08.42	34.10	26.53	1.133	0.605
600	06.61	34.03	26.73	1.284	0.454
700	05.19	34.01	26.89	1.416	0.322
800	04.59	34.08	27.01	1.535	0.203
1000	03.59	34.26	27.26	1.738	0.000

* Colorimeter out of operation, no PO_4-P analyses stations No. 19 to No. 24.

Table 1.--Oceanographic station data (cont'd)

STATION 20

M/V Charles H. Gilbert: Cruise 17, 32°29'N., 170°17'W., October 8, 1954. Messenger time: 2000 GCT. Weather: 02, cloud coverage 1. Wind: 220°, 8 kt. Sea: <1 ft. Wire angle: 20°. BT slide: 101

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	23.17	34.78	23.74	3.99	- *
19	22.94	34.81	23.83	4.05	-
38	21.02	34.99	24.50	4.73	-
58	18.68	34.85	25.00	5.06	-
90	16.67	34.69	25.37	4.55	-
155	15.13	34.58	25.64	4.08	-
222	14.15	34.49	25.78	4.30	-
340	12.37	34.38	26.06	4.40	-
447	10.75	34.29	26.29	4.25	-
554	08.30	34.11	26.55	3.83	-
672	06.54	34.02	26.73	3.43	-
898	04.33	34.13	27.08	1.23	-
1126	03.04	34.29	27.34	0.54	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.17	34.78	23.74	0.000	1.840
10	23.08	34.79	23.77	0.042	1.798
20	22.92	34.81	23.83	0.083	1.757
30	22.90	34.82	23.85	0.123	1.717
50	19.22	34.88	24.89	0.195	1.645
75	17.60	34.76	25.20	0.269	1.571
100	16.25	34.66	25.45	0.336	1.504
150	15.20	34.59	25.63	0.460	1.380
200	14.45	34.52	25.74	0.579	1.261
250	13.70	34.46	25.85	0.692	1.148
300	12.95	34.42	25.97	0.801	1.039
400	11.48	34.33	26.19	1.003	0.837
500	09.55	34.21	26.43	1.185	0.655
600	07.48	34.08	26.65	1.345	0.495
700	06.20	34.01	26.77	1.489	0.351
800	05.18	33.98	26.87	1.622	0.218
1000	03.58	34.25	27.25	1.840	0.000

* See Station 19

Table 1.--Oceanographic station data (cont'd)

STATION 21

M/V Charles H. Gilbert: Cruise 17, 31°12'N., 170°10'W., October 9, 1954. Messenger time: 0651 GCT. Weather: 02, clear. Wind: 180°, 14 kt. Sea: 1-3 ft. Wire angle: 05°. BT slide: 103

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σt	O_2 (ml/l)	PO_4-P (µg at/l)
0	23.78	34.81	23.55	4.47	- *
15	23.38	34.85	23.73	4.66	-
31	23.11	34.92	23.86	4.74	-
55	17.97	34.78	25.13	5.48	-
93	16.39	34.72	25.46	5.06	-
149	15.30	34.61	25.62	4.73	-
240	13.88	34.51	25.85	4.83	-
367	11.86	34.34	26.12	5.00	-
484	09.71	34.18	26.38	4.89	-
612	07.18	34.02	26.65	3.75	-
728	05.53	33.96	26.81	2.76	-
969	03.98	34.18	27.16	0.83	-
1206	03.03	34.36	27.39	0.38	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σt	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.78	34.81	23.58	0.000	1.829
10	23.42	34.84	23.71	0.043	1.786
20	23.32	34.86	23.76	0.084	1.745
30	23.15	34.91	23.84	0.126	1.703
50	18.25	34.80	25.08	0.195	1.634
75	16.86	34.74	25.37	0.265	1.564
100	16.20	34.70	25.49	0.330	1.499
150	15.29	34.61	25.63	0.453	1.376
200	14.46	34.55	25.76	0.571	1.258
250	13.72	34.50	25.88	0.684	1.145
300	12.98	34.44	25.98	0.791	1.038
400	11.27	34.29	26.19	0.993	0.836
500	09.40	34.16	26.42	1.175	0.654
600	07.40	34.03	26.62	1.337	0.492
700	05.80	33.96	26.78	1.481	0.348
800	04.90	34.01	26.92	1.610	0.219
1000	03.80	34.20	27.19	1.829	0.000

* See Station 19

Table 1.--Oceanographic station data (cont'd)

STATION 22

M/V Charles H. Gilbert: Cruise 17, 30°00'N., 170°10'W., October 9, 1954. Messenger time: 1651 GCT. Weather: 02, cloud coverage 1. Wind: 090°, 8 kt. Sea: <1 ft. Wire angle: 34°. BT slide: 106

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.70	35.12	23.54	4.31	- *
17	24.40	35.07	23.59	4.23	-
29	24.76	35.41	23.74	4.45	-
42	22.00	35.23	24.41	4.86	-
71	19.87	35.23	24.99	4.74	-
118	18.13	34.97	25.23	4.46	-
194	15.53	34.65	25.60	4.56	-
297	13.80	34.49	25.85	4.81	-
393	11.50	34.29	26.15	4.32	-
495	10.19	34.23	26.34	4.28	-
591	07.57	34.07	26.63	3.63	-
811	04.85	34.09	26.99	1.66	-
1034	03.03	34.29	27.34	0.44	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.70	35.12	23.54	0.000	1.884
10	24.41	35.07	23.59	0.043	1.841
20	24.63	35.27	23.68	0.086	1.798
30	24.75	35.40	23.74	0.128	1.756
50	21.10	35.23	24.66	0.203	1.681
75	19.70	35.22	25.03	0.281	1.603
100	18.59	35.03	25.17	0.354	1.530
150	16.90	34.81	25.41	0.491	1.393
200	15.40	34.63	25.62	0.617	1.267
250	14.61	34.56	25.74	0.737	1.147
300	13.70	34.48	25.87	0.851	1.033
400	11.40	34.28	26.16	1.060	0.824
500	10.08	34.22	26.35	1.247	0.637
600	07.40	34.06	26.64	1.411	0.473
700	06.15	34.03	26.79	1.554	0.330
800	05.00	34.08	26.97	1.681	0.203
1000	03.20	34.27	27.31	1.884	0.000

* See Station 19

Table 1.--Oceanographic station data (cont'd)

STATION 23

M/V Charles H. Gilbert: Cruise 17, 29°45'N., 172°05'W., October 10, 1954. Messenger time: 0548 GCT. Weather: 02, cloud coverage 1. Wind: 110°, 12 kt. Sea: 1-3 ft. Wire angle: 14°. BT slide: 109

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.99	35.16	23.48	4.07	- *
15	24.75	35.12	23.53	4.08	-
30	24.36	35.07	23.61	4.42	-
41	22.59	35.03	24.10	4.56	-
61	18.81	34.92	25.03	5.23	-
112	16.34	34.72	25.47	4.92	-
238	13.81	34.45	25.82	4.57	-
360	11.34	34.31	26.19	4.59	-
474	09.12	34.18	26.48	4.38	-
598	06.73	34.05	26.73	3.41	-
712	05.23	34.07	26.93	2.15	-
950	03.88	34.27	27.24	0.64	-
1182	03.25	34.45	27.44	0.58	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	24.99	35.16	23.49	0.000	1.774
10	24.82	35.13	23.52	0.044	1.730
20	24.60	35.10	23.56	0.088	1.686
30	24.36	35.07	23.61	0.131	1.643
50	19.52	34.95	24.87	0.205	1.569
75	18.10	34.86	25.16	0.279	1.495
100	16.80	34.76	25.40	0.348	1.426
150	15.50	34.63	25.59	0.474	1.300
200	14.51	34.51	25.72	0.594	1.180
250	13.58	34.44	25.86	0.708	1.066
300	12.59	34.38	26.01	0.815	0.959
400	10.52	34.26	26.30	1.010	0.764
500	08.60	34.14	26.53	1.181	0.593
600	06.65	34.05	26.74	1.331	0.443
700	05.38	34.06	26.91	1.463	0.311
800	04.60	34.14	27.06	1.579	0.195
1000	03.70	34.32	27.30	1.774	0.000

* See Station 19

Table 1.--Oceanographic station data (cont'd)

STATION 24

M/V Charles H. Gilbert: Cruise 17, 29°17'N., 173°54'W., October 10, 1954. Messenger time: 1824 GCT. Weather: 02, cloud coverage 2. Wind: 090°, 12 kt. Sea: 1-3 ft. Wire angle: 20°. BT slide: 112

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.86	35.17	23.53	3.76	- *
15	24.85	35.17	23.53	3.82	-
33	23.62	35.08	23.84	4.58	-
60	19.24	34.88	24.88	5.52	-
110	16.59	34.76	25.45	4.74	-
160	15.28	34.61	25.63	4.82	-
228	13.98	34.49	25.81	4.77	-
350	11.64	34.33	26.15	4.69	-
460	09.78	34.18	26.37	4.42	-
570	07.22	34.05	26.66	3.64	-
690	05.60	34.05	26.87	2.53	-
920	04.00	34.43	27.36	0.76	-
1150	03.30	34.40	27.40	0.63	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.86	35.17	23.53	0.000	1.767
10	24.86	35.17	23.53	0.044	1.723
20	24.85	35.17	23.54	0.087	1.680
30	24.08	35.10	23.71	0.130	1.637
50	19.73	34.90	24.78	0.204	1.563
75	18.54	34.85	25.04	0.281	1.486
100	16.88	34.78	25.39	0.351	1.416
150	15.62	34.65	25.58	0.478	1.289
200	14.61	34.54	25.72	0.598	1.169
250	13.58	34.46	25.88	0.711	1.056
300	12.61	34.39	26.02	0.818	0.949
400	10.82	34.27	26.26	1.015	0.752
500	08.85	34.11	26.47	1.191	0.576
600	06.70	34.03	26.72	1.345	0.422
700	05.50	34.06	26.89	1.479	0.288
800	04.75	34.30	27.17	1.591	0.176
1000	03.61	34.43	27.39	1.767	0.000

* See Station 19

Table 1.--Oceanographic station data (cont'd)

STATION 25

M/V Charles H. Gilbert: Cruise 17, 28°48'N., 178°18'W., October 15, 1954. Messenger time: 0850 GCT. Weather: 02, cloud coverage 6. Wind: 090°, 10 kt. Sea: 1-3 ft. Wire angle: 15°. BT slide: 114

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	25.32	35.16	23.39	5.05	0.21
20	25.34	35.16	23.38	5.06	0.23
40	23.40	35.05	23.88	5.30	0.15
60	21.22	34.87	24.35	5.53	0.14
91	17.81	34.72	25.12	5.44	0.22
142	16.20	34.67	25.47	4.12 Q	0.43
232	14.71	34.52	25.68	4.81	0.62
353	12.46	34.38	26.04	4.95	1.22
463	10.71	34.20	26.22	4.77	1.35
584	08.30	34.07	26.52	4.23	1.83
695	05.99	34.00	26.79	3.25	2.51
926	04.08	34.18	27.15	1.09	2.93
1158	03.33	34.36	27.36	0.55	3.27

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	25.32	35.16	23.39	0.000	1.932
10	25.33	35.16	23.38	0.045	1.887
20	25.34	35.16	23.38	0.090	1.842
30	25.30	35.16	23.39	0.135	1.797
50	22.28	34.95	24.12	0.219	1.713
75	19.40	34.78	24.77	0.307	1.625
100	17.40	34.71	25.22	0.382	1.550
150	16.05	34.66	25.49	0.515	1.417
200	15.22	34.57	25.61	0.640	1.292
250	14.40	34.50	25.74	0.759	1.173
300	13.48	34.44	25.88	0.873	1.059
400	11.70	34.30	26.12	1.083	0.849
500	10.02	34.14	26.30	1.275	0.657
600	07.99	34.05	26.55	1.446	0.486
700	05.90	34.00	26.80	1.593	0.339
800	04.96	34.05	26.95	1.721	0.211
1000	03.72	34.26	27.25	1.932	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 26

M/V Charles H. Gilbert: Cruise 17, 29°51'N., 179°45'E., October 16, 1954. Messenger time: 0120 GCT. Weather: 02, cloud coverage 1. Wind: 150°, 5 kt. Sea: <1 ft. Wire angle: 02°. BT slide: 119

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	25.08	34.99	23.33	4.72	0.13
16	24.70	34.99	23.45	4.83	0.15
31	24.46	34.99	23.52	4.86	0.01
47	20.25	34.79	24.55	5.71	0.09
89	17.02	NS	-	5.42	0.16
146	16.08	34.67	25.50	4.87	0.27
240	14.82	34.54	25.68	5.05	0.64
367	12.90	34.43	25.99	4.89	0.75
483	10.76	34.29	26.28	4.69	0.91
609	07.74	34.05	26.59	4.23	1.84
726	05.67	34.04	26.86	2.85	2.43
967	04.05	34.16	27.14	0.93	2.77
1204	03.34	34.38	27.38	0.78	3.14

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	25.08	34.99	23.33	0.000	1.916
10	24.79	34.99	23.42	0.045	1.871
20	24.65	34.99	23.46	0.090	1.826
30	24.47	34.99	23.51	0.134	1.782
50	19.80	34.77	24.66	0.211	1.705
75	17.58	34.72	25.18	0.288	1.628
100	16.78	34.71	25.36	0.356	1.560
150	16.05	34.66	25.49	0.486	1.430
200	15.41	34.60	25.59	0.611	1.305
250	14.70	34.54	25.70	0.732	1.184
300	13.97	34.49	25.82	0.848	1.068
400	12.35	34.40	26.08	1.064	0.852
500	10.40	34.26	26.33	1.257	0.659
600	07.92	34.06	26.57	1.426	0.490
700	06.01	34.02	26.80	1.572	0.344
800	04.99	34.07	26.96	1.699	0.217
1000	03.90	34.19	27.17	1.916	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 27

M/V *Charles H. Gilbert*: Cruise 17, 31°30'N., 179°37'E., October 16, 1954. Messenger time: 1420 GCT. Weather: 02, cloud coverage 2. Wind: 180°, 04 kt. Sea: <1 ft. Wire angle: 07°. BT slide: 122

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.00	34.83	23.53	4.83	0.01
21	23.58	34.78	23.62	4.82	0.00
42	20.58	34.70	24.40	5.44	0.09
69	18.78	34.70	24.86	5.49	0.06
119	16.60	34.76	25.44	4.78	NS
171	16.05	34.70	25.53	4.72	0.35
240	15.31	34.63	25.64	4.69	0.53
366	13.38	34.45	25.91	4.79	0.89
478	11.36	34.34	26.21	4.37	1.04
606	08.54	34.09	26.50	3.52	1.65
720	05.81	33.98	26.79	1.29	2.37
959	04.08	34.18	27.15	0.72	3.13
1195	03.34	34.31	27.32	NS	3.37

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.00	34.83	23.53	0.000	1.952
10	24.00	34.83	23.53	0.044	1.908
20	23.60	34.79	23.62	0.087	1.865
30	23.19	34.74	23.70	0.129	1.823
50	19.97	34.70	24.56	0.206	1.746
75	18.22	34.72	25.02	0.285	1.667
100	16.98	34.76	25.35	0.356	1.596
150	16.28	34.72	25.49	0.486	1.466
200	15.77	34.67	25.56	0.612	1.340
250	15.15	34.61	25.66	0.735	1.217
300	14.45	34.54	25.76	0.853	1.099
400	12.74	34.41	26.01	1.075	0.877
500	10.90	34.30	26.27	1.275	0.677
600	08.66	34.10	26.49	1.451	0.501
700	06.22	33.98	26.74	1.605	0.347
800	04.99	34.06	26.95	1.735	0.217
1000	03.94	34.20	27.18	1.952	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 28

M/V Charles H. Gilbert: Cruise 17, 32°59'N., 179°58'E., October 17, 1954. Messenger time: 0214 GCT. Weather: 02, cloud coverage 3. Wind: 080°, 22 kt. Sea: 1-3 ft. Wire angle: 26°. BT slide: 125

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	23.20	34.47	23.50	4.96	0.16
14	23.20	34.47	23.50	4.97	0.08
27	22.56	34.45	23.67	4.91	0.20
56	19.44	34.67	24.67	5.20	0.18
91	17.50	34.72	25.20	4.82	0.45
141	15.90	34.63	25.50	4.74	0.61
209	13.86	34.51	25.86	4.95	0.77
320	11.85	34.38	26.15	4.99	1.02
420	09.81	34.22	26.39	5.08	1.42
532	07.41	34.07	26.65	4.37	2.02
633	05.64	34.00	26.83	3.42	2.41
846	04.17	34.16	27.12	1.47	2.87
1070	03.34	34.34	27.35	0.74	3.01

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.20	34.47	23.50	0.000	1.761
10	23.20	34.47	23.50	0.044	1.717
20	23.14	34.47	23.51	0.088	1.673
30	22.22	34.46	23.77	0.131	1.630
50	20.70	34.58	24.28	0.209	1.552
75	18.38	34.72	24.98	0.293	1.468
100	17.28	34.71	25.24	0.365	1.396
150	15.54	34.62	25.58	0.495	1.266
200	14.04	34.52	25.83	0.613	1.148
250	13.10	34.46	25.97	0.721	1.040
300	12.22	34.41	26.11	0.824	0.937
400	10.23	34.25	26.35	1.012	0.749
500	08.14	34.10	26.57	1.178	0.583
600	06.15	34.01	26.77	1.324	0.437
700	05.08	34.05	26.94	1.453	0.308
800	04.43	34.12	27.06	1.567	0.194
1000	03.48	34.30	27.30	1.761	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 29

M/V Charles H. Gilbert: Cruise 17, 34°30'N., 179°52'E., October 17, 1954. Messenger time: 1426 GCT. Weather: 02, cloud coverage 3. Wind: 120°, 18 kt. Sea: 1-3 ft. Wire angle: 33°. BT slide: 128

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	22.06	34.22	23.63	4.97	0.13
16	22.04	34.29	23.69	5.08	0.22
33	19.88	34.34	24.31	5.91	0.18
50	15.84	34.25	25.22	6.74	0.27
83	13.53	34.45	25.88	5.31	0.82
131	12.49	34.34	26.00	5.19	0.95
193	11.64	34.34	26.16	5.03	1.06
294	10.16	34.16	26.29	5.22	1.17
387	08.70	34.11	26.49	4.91	1.46
489	06.98	33.95	26.62	4.25	2.05
584	05.54	34.00	26.84	3.21	2.61
788	04.19	34.11	27.08	1.48	2.77
1003	03.46	34.31	27.31	0.74	3.30

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	22.06	34.22	23.63	0.000	1.577
10	22.05	34.26	23.66	0.043	1.534
20	22.03	34.31	23.71	0.085	1.492
30	22.00	34.32	23.72	0.127	1.450
50	15.84	34.25	25.23	0.196	1.381
75	13.88	34.43	25.79	0.259	1.318
100	13.10	34.41	25.94	0.313	1.264
150	12.23	34.34	26.05	0.416	1.161
200	11.57	34.33	26.17	0.514	1.063
250	10.82	34.24	26.24	0.607	0.970
300	10.04	34.16	26.31	0.698	0.879
400	08.48	34.08	26.50	0.868	0.709
500	06.78	33.95	26.64	1.022	0.555
600	05.38	34.01	26.87	1.159	0.418
700	04.62	34.06	27.00	1.279	0.298
800	04.13	34.13	27.10	1.388	0.189
1000	03.45	34.31	27.31	1.577	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 30

M/V Charles H. Gilbert: Cruise 17, 36°02'N., 179°58'E., October 18, 1954. Messenger time: 0319 GCT. Weather: 01, cloud coverage 8. Wind: 190°, 22 kt. Sea: 3-5 ft. Wire angle: 36°. BT slide: 131

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	20.54	34.20	24.03	5.15	0.25
19	20.51	34.29	24.10	5.12	0.24
35	20.48	34.22	24.06	5.16	0.18
52	19.51	34.42	24.47	5.46	0.26
96	15.65	34.60	25.54	5.16	0.54
143	14.18	34.43	25.73	4.96	0.79
200	13.29	34.45	25.93	4.88	0.86
305	11.74	34.27	26.09	5.05	1.06
404	09.84	34.23	26.40	4.99	1.31
511	07.78	34.00	26.54	4.48	1.88
611	06.05	34.00	26.78	3.81	2.25
828	04.32	34.07	27.03	1.63	2.96
1053	03.49	34.31	27.31	0.87	3.02

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	20.54	34.20	24.03	0.000	1.725
10	20.53	34.25	24.07	0.039	1.686
20	20.51	34.29	24.11	0.077	1.648
30	20.49	34.24	24.07	0.116	1.609
50	19.85	34.37	24.34	0.190	1.535
75	16.80	34.64	25.30	0.269	1.456
100	15.50	34.59	25.56	0.334	1.391
150	14.05	34.43	25.76	0.452	1.273
200	13.29	34.45	25.93	0.563	1.162
250	12.59	34.36	26.00	0.669	1.056
300	11.81	34.28	26.09	0.771	0.954
400	09.94	34.24	26.39	0.958	0.767
500	08.01	34.02	26.52	1.124	0.601
600	06.21	34.00	26.76	1.273	0.452
700	05.19	34.02	26.90	1.404	0.321
800	04.47	34.06	27.01	1.522	0.203
1000	03.58	34.26	27.26	1.725	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 31

M/V Charles H. Gilbert: Cruise 17, 39°28'N., 179°38'E., October 20, 1954. Messenger time: 2037 GCT. Weather: 02, cloud coverage 7. Wind: 140°, 12 kt. Sea: 1-3 ft. Wire angle: 16°. BT slide: 140

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	15.24	34.07	25.22	5.76	0.32
20	15.24	33.95	25.13	5.87	0.29
41	15.04	34.00	25.22	5.81	0.32
61	13.21	34.33	25.85	5.45	0.77
91	11.76	34.33	26.13	5.46	0.93
147	10.44	34.25	26.31	5.52	1.18
233	08.60	34.11	26.50	5.59	1.27
355	06.68	34.02	26.71	4.62	1.82
467	05.38	33.98	26.84	3.48	2.35
587	04.44	34.07	27.02	2.30	2.87
700	04.08	34.16	27.13	1.52	2.95
929	03.50	34.31	27.31	0.84	3.27
PT	-	-	-	-	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	15.24	34.07	25.22	0.000	1.337
10	15.24	34.01	25.18	0.028	1.309
20	15.24	33.95	25.13	0.056	1.281
30	15.20	33.96	25.15	0.084	1.253
50	14.87	34.02	25.26	0.140	1.197
75	12.38	34.36	26.04	0.199	1.138
100	11.53	34.31	26.16	0.248	1.089
150	10.38	34.24	26.31	0.339	0.998
200	09.22	34.16	26.45	0.423	0.914
250	08.35	34.10	26.54	0.503	0.834
300	07.53	34.06	26.63	0.578	0.759
400	06.16	33.99	26.76	0.719	0.618
500	05.02	34.00	26.90	0.848	0.489
600	04.39	34.08	27.04	0.963	0.374
700	04.08	34.16	27.13	1.067	0.270
800	03.82	34.24	27.22	1.164	0.173
1000	03.51	34.36	27.35	1.337	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 32

M/V Charles H. Gilbert: Cruise 17, 45°00'N., 179°27'E., October 23, 1954. Messenger time: 2137 GCT. Weather: 02, cloud coverage 7. Wind: 250°, 25 kt. Sea: 3-5 ft. Wire angle: 51°. BT slide: 151

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	09.56	33.42	25.81	6.42	1.16
17	09.56	33.48	25.85	6.48	1.22
35	09.56	33.51	25.88	6.45	1.15
43	09.57	33.42	25.81	6.43	1.17
63	09.55	33.35	25.76	6.46	1.21
87	07.86	33.69	26.29	6.43	1.33
130	07.38	33.78	26.42	6.40	1.35
198	06.53	33.80	26.56	6.40	1.43
259	06.21	33.84	26.63	5.48	1.68
332	05.38	33.86	26.75	4.55	2.06
408	04.79	33.89	26.84	3.26	2.43
590	04.10	34.09	27.08	1.66	2.72
792	03.56	34.22	27.23	0.96	2.90

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	09.56	33.42	-	-	-
10	09.56	33.44	-	-	-
20	09.56	33.49	-	-	-
30	09.56	33.50	-	-	-
50	09.56	33.38	-	-	-
75	09.48	33.35	-	-	-
100	07.62	33.75	-	-	-
150	07.12	33.79	-	-	-
200	06.49	33.81	-	-	-
250	06.25	33.84	-	-	-
300	05.72	33.85	-	-	-
400	04.81	33.88	-	-	-
500	04.40	33.97	-	-	-
600	04.05	34.10	-	-	-
700	03.79	34.16	-	-	-
800	03.54	34.23	-	-	-

Table 1.--Oceanographic station data (cont'd)

STATION 33

M/V Charles H. Gilbert: Cruise 17, 44°57'N., 175°47'E., October 24, 1954. Messenger time: 2326 GCT. Weather: 02, cloud coverage 6. Wind: 340°, 14 kt. Sea: 3-5 ft. Wire angle: 06°. BT slide: 156

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	08.54	33.22	25.82	6.62	1.38
30	08.52	33.28	25.87	6.61	1.37
66	07.76	33.53	26.18	6.46	1.29
98	06.76	33.69	26.44	6.43	1.31
141	05.84	33.71	26.57	6.36	1.43
183	05.54	33.77	26.66	6.10	1.56
246	04.98	33.84	26.78	4.66	1.96
373	04.20	33.93	26.94	2.75	2.55
489	03.92	34.04	27.05	1.86	2.73
613	03.57	34.16	27.18	1.09	2.76
726	03.38	34.25	27.27	0.87	2.89
961	03.02	34.36	27.39	0.80	2.86
PT	-	-	-	-	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	08.54	33.22	25.82	0.000	1.132
10	08.54	33.23	25.83	0.022	1.110
20	08.53	33.25	25.84	0.044	1.088
30	08.52	33.28	25.87	0.065	1.067
50	08.52	33.40	25.96	0.107	1.025
75	07.39	33.59	26.28	0.155	0.977
100	06.66	33.69	26.46	0.197	0.935
150	05.79	33.72	26.59	0.274	0.858
200	05.39	33.80	26.70	0.345	0.787
250	04.92	33.85	26.80	0.412	0.720
300	04.49	33.89	26.87	0.474	0.658
400	04.12	33.96	26.97	0.591	0.541
500	03.86	34.07	27.08	0.699	0.433
600	03.60	34.14	27.16	0.799	0.333
700	03.40	34.23	27.26	0.890	0.242
800	03.24	34.28	27.31	0.975	0.157
1000	03.00	34.38	27.41	1.132	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 34

M/V Charles H. Gilbert: Cruise 17, 35°45'N., 171°32'E., October 28, 1954. Messenger time: 1910 GCT. Weather: 02, cloud coverage 8. Wind: 060°, 07 kt. Sea: 1-3 ft. Wire angle: 30°. BT slide: 175

OBSERVED

DEPTH * (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	NG	34.38	-	5.15	0.27
21	20.28	34.49	24.32	5.21	0.30
46	20.26	34.49	24.33	5.15	0.20
74	20.10	34.49	24.37	4.92	0.33
106	18.23	34.78	25.06	4.08	0.70
145	16.72	34.79	25.44	4.69	0.63
180	15.94	34.74	25.58	4.64	0.62
251	14.00	34.58	25.88	4.43	0.89
312	12.32	34.49	26.15	4.78	1.03
381	11.76	34.45	26.23	4.48	1.17
**	-	-	-	-	-
**	-	-	-	-	-
**	-	-	-	-	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	20.30	34.38	-	-	-
10	20.29	34.44	-	-	-
20	20.28	34.49	-	-	-
30	20.27	34.49	-	-	-
50	20.26	34.49	-	-	-
75	20.09	34.49	-	-	-
100	19.82	34.51	-	-	-
150	16.60	34.79	-	-	-
200	15.47	34.70	-	-	-
250	14.10	34.59	-	-	-
300	12.54	34.50	-	-	-
400	11.65	34.45	-	-	-

* All depths somewhat questionable.

** Last three bottles apparently fouled a ridge.

Table 1.--Oceanographic station data (cont'd)

STATION 35

M/V Charles H. Gilbert: Cruise 17, 31°23'N., 172°01'E., October 29, 1954. Messenger time: 0549 GCT. Weather: 02, cloud coverage 6. Wind: 170°, 18 kt. Sea: 5-8 ft. Wire angle: 27°. BT slide: 184

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	23.12	34.69	23.69	4.90	0.29
23	22.96	34.76	23.78	4.88	0.28
51	22.94	34.74	23.77	4.88	0.23
69	21.10	34.74	24.29	5.31	0.25
97	18.38	34.76	25.01	5.21	0.33
149	16.73	34.74	25.40	4.88	0.56
204	16.10	NS	-	4.70	0.63
308	14.70	NS	-	4.55	0.74
414	12.66	34.45	26.05	4.78	1.05
521	10.38	34.34	26.39	4.65	1.40
628	07.31	33.96	26.58	4.23	1.98
846	NG	34.22	-	1.71	3.64
1064	03.52	34.36	27.35	0.87	3.46

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.12	34.69	23.68	0.000	1.967
10	23.00	34.74	23.76	0.042	1.925
20	22.97	34.76	23.78	0.083	1.884
30	22.95	34.75	23.78	0.125	1.842
50	22.94	34.74	23.77	0.208	1.759
75	20.15	34.75	24.55	0.302	1.665
100	18.18	34.76	25.06	0.382	1.585
150	16.72	34.74	25.40	0.521	1.446
200	16.17	34.70	25.50	0.651	1.316
250	15.55	34.66	25.61	0.776	1.191
300	14.81	34.60	25.72	0.897	1.070
400	12.95	34.46	26.00	1.121	0.846
500	10.99	34.36	26.30	1.319	0.648
600	07.99	34.02	26.53	1.492	0.475
700	06.20	34.02	26.78	1.641	0.326
800	05.15	34.17	27.02	1.767	0.200
1000	03.74	34.33	27.30	1.967	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 36

M/V Charles H. Gilbert: Cruise 17, 30°59'N., 173°52'E., October 30, 1954. Messenger time: 1852 GCT. Weather: 60, cloud coverage 8. Wind: 200°, 14 kt. Sea: 3-5 ft. Wire angle: 29°. BT slide: 187

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.52	34.94	23.46	4.65	0.04
26	24.54	35.35	23.76	4.71	0.04
52	24.46	35.35	23.79	4.70	0.12
66	20.38	34.97	24.66	5.42	0.11
83	18.47	34.83	25.04	5.27	0.19
137	16.58	34.70	25.40	4.89	0.40
195	15.82	34.65	25.54	4.78	0.56
293	14.02	34.52	25.83	4.63	0.84
391	12.14	34.40	26.12	4.70	1.07
490	10.24	34.23	26.33	4.42	1.35
590	07.81	34.13	26.64	4.01	1.87
798	04.82	34.13	27.03	1.98	2.90
1008	03.80	34.31	27.28	0.86	3.36

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	24.52	34.94	23.46	0.000	1.900
10	24.53	35.06	23.55	0.044	1.856
20	24.54	35.26	23.70	0.087	1.813
30	24.54	35.35	23.77	0.129	1.771
50	24.47	35.35	23.79	0.212	1.688
75	19.12	34.87	24.91	0.302	1.598
100	17.56	34.76	25.21	0.375	1.525
150	16.39	34.68	25.43	0.510	1.390
200	15.78	34.65	25.55	0.638	1.262
250	14.92	34.59	25.69	0.760	1.140
300	13.94	34.51	25.84	0.876	1.024
400	11.98	34.38	26.13	1.088	0.812
500	10.02	34.22	26.36	1.276	0.624
600	07.61	34.12	26.66	1.439	0.461
700	06.01	34.09	26.85	1.578	0.322
800	04.81	34.13	27.03	1.699	0.201
1000	03.81	34.31	27.28	1.900	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 37

M/V Charles H. Gilbert: Cruise 17, 30°15'N., 175°36'E., October 31, 1954. Messenger time: 0756 GCT. Weather: 02, cloud coverage not recorded. Wind: 190°, 14 kt. Sea: 1-3 ft. Wire angle: 27°. BT slide: 190

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.75	35.37	23.72	4.70	0.23
22	24.72	35.35	23.71	4.71	0.22
49	24.63	35.37	23.75	4.67	0.17
63	24.17	35.30	23.84	4.85	0.29
99	17.91	34.83	25.18	5.60	0.28
126	16.54	34.72	25.43	5.23	0.42
198	15.12	34.61	25.66	4.80	0.70
296	13.61	34.49	25.89	4.69	0.93
396	11.63	34.33	26.15	4.61	1.23
495	09.77	34.20	26.39	4.41	1.66
595	07.73	34.11	26.63	4.05	1.88
796	04.82	34.09	27.00	2.09	3.28
976	03.71	34.25	27.24	0.78	3.70

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.75	35.37	23.72	0.000	1.885
10	24.74	35.36	23.71	0.042	1.843
20	24.72	35.35	23.71	0.084	1.801
30	24.70	35.36	23.72	0.126	1.759
50	24.62	35.37	23.76	0.210	1.675
75	19.50	34.94	24.87	0.301	1.584
100	17.80	34.82	25.20	0.375	1.510
150	15.86	34.67	25.54	0.507	1.378
200	15.09	34.61	25.67	0.629	1.256
250	14.40	34.55	25.77	0.747	1.138
300	13.55	34.48	25.90	0.859	1.026
400	11.58	34.32	26.16	1.067	0.818
500	09.64	34.20	26.41	1.251	0.634
600	07.62	34.10	26.64	1.412	0.473
700	05.99	34.05	26.83	1.553	0.332
800	04.80	34.09	27.00	1.677	0.208
1000	03.71	34.24	27.23	1.885	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 38

M/V Charles H. Gilbert: Cruise 17, 29°39'N., 177°19'E., October 31, 1954. Messenger time: 2041 GCT. Weather: 02, cloud coverage 1. Wind: 210°, 18 kt. Sea: 3-5 ft. Wire angle: 25°. BT slide: 193

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	25.63	35.59	23.61	4.59	0.12
30	25.63	35.55	23.58	4.61	0.15
60	25.64	35.57	23.59	4.57	0.09
70	22.98	35.32	24.20	5.23	0.14
100	20.32	35.17	24.83	4.84	0.17
160	17.24	34.79	25.31	4.91	0.42
220	16.13	34.69	25.50	4.91	0.59
330	14.47	34.56	25.77	4.57	0.81
440	12.12	34.38	26.11	4.68	1.10
550	10.00	34.23	26.37	4.38	1.36
660	07.35	NG	-	NG	NG
880	04.83	34.11	27.01	1.67	3.46
1163	03.37	34.40	27.39	0.59	3.64

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	25.63	35.59	23.61	0.000	2.040
10	25.63	35.58	23.61	0.043	1.997
20	25.63	35.57	23.60	0.086	1.954
30	25.63	35.55	23.58	0.129	1.911
50	25.64	35.57	23.60	0.216	1.824
75	22.28	35.26	24.36	0.315	1.725
100	20.32	35.17	24.83	0.400	1.640
150	17.60	34.82	25.25	0.548	1.492
200	16.42	34.72	25.45	0.683	1.357
250	15.70	34.66	25.57	0.810	1.230
300	15.00	34.60	25.68	0.932	1.108
400	12.98	34.45	25.99	1.159	0.881
500	10.98	34.30	26.25	1.360	0.680
600	08.62	34.17	26.55	1.534	0.506
700	06.67	34.08	26.76	1.684	0.356
800	05.52	34.07	26.90	1.817	0.223
1000	04.04	34.22	27.18	2.040	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 39

M/V Charles H. Gilbert: Cruise 17, 28°55'N., 178°50'E., November 1, 1954. Messenger time: 0832 GCT. Weather: 02, cloud coverage 1. Wind: 220°, 13 kt. Sea: 1-3 ft. Wire angle: 15°. BT slide: 196

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	24.12	35.17	23.76	4.83	0.16
26	24.12	35.16	23.75	4.82	0.20
44	21.28	34.90	24.36	5.54	0.18
62	19.76	34.88	24.75	5.64	0.16
92	17.89	34.85	25.20	5.38	0.33
149	16.29	34.69	25.46	4.95	0.48
225	15.29	34.65	25.66	4.81	0.62
337	13.34	34.51	25.96	4.95	0.83
449	11.52	34.33	26.18	4.81	1.16
561	09.15	34.18	26.47	4.21	1.67
673	06.80	34.25	26.88	3.94	1.77
895	04.83	34.16	27.04	1.35	3.43
1076	03.58	34.36	27.34	0.68	3.54

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.12	35.17	23.76	0.000	1.894
10	24.12	35.17	23.76	0.042	1.852
20	24.12	35.16	23.75	0.083	1.811
30	24.11	35.16	23.75	0.125	1.769
50	20.62	34.88	24.52	0.201	1.693
75	18.85	34.88	24.99	0.281	1.613
100	17.62	34.82	25.25	0.354	1.540
150	16.30	34.69	25.46	0.487	1.407
200	15.65	34.66	25.58	0.613	1.281
250	14.90	34.63	25.73	0.734	1.160
300	14.00	34.56	25.87	0.848	1.046
400	12.32	34.41	26.09	1.061	0.833
500	10.53	34.26	26.30	1.254	0.640
600	08.22	34.19	26.63	1.422	0.472
700	06.45	34.24	26.92	1.561	0.333
800	05.59	34.19	26.99	1.682	0.212
1000	04.01	34.27	27.23	1.894	0.000

Table 1.--Oceanographic station data (cont'd)

STATION 40

M/V Charles H. Gilbert: Cruise 17, 28°11'N., 179°43'W., November 1, 1954. Messenger time: 1928 GCT. Weather: 02, cloud coverage 1. Wind: 260°, 10 kt. Sea: <1 ft. Wire angle: 15°. BT slide: 199

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.19	35.14	23.71	4.74	0.21
20	24.19	35.14	23.71	4.75	0.14
35	24.19	35.16	23.73	4.77	0.17
50	20.51	34.84	24.52	5.67	0.19
76	17.58	34.72	25.18	5.59	0.21
132	16.08	34.65	25.48	4.91	0.54
224	15.09	34.52	25.60	4.89	0.72
337	13.38	34.43	25.89	4.75	0.97
449	11.21	34.29	26.20	4.76	1.29
561	08.77	34.13	26.49	4.39	1.83
671	06.30	34.27	26.96	4.06	1.52 P
892	04.16	34.22	27.17	1.00	3.56
1112	03.40	34.47	27.45	0.61	3.55

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.19	35.14	23.71	0.000	1.854
10	24.19	35.14	23.71	0.042	1.812
20	24.19	35.14	23.71	0.084	1.770
30	24.19	35.15	23.72	0.126	1.728
50	20.51	34.84	24.52	0.202	1.652
75	17.60	34.72	25.17	0.281	1.573
100	16.75	34.68	25.35	0.349	1.505
150	15.87	34.62	25.50	0.479	1.375
200	15.36	34.54	25.56	0.605	1.249
250	14.78	34.50	25.65	0.728	1.126
300	14.02	34.47	25.79	0.846	1.008
400	12.19	34.33	26.05	1.064	0.790
500	10.15	34.22	26.34	1.257	0.597
600	07.85	34.19	26.68	1.420	0.434
700	05.86	34.25	27.00	1.552	0.302
800	04.76	34.23	27.11	1.662	0.192
1000	03.70	34.30	27.28	1.854	0.000

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
1	2345	9/18	22°30'N	160°00'W	79.1	100	24	79.9	76.2	1015.2	01	6	5	9	3
2	0405	9/19	22°29'N	160°02'W	79.4	070	16	78.2	72.9	1011.2	02	9	4	9	4
3	0800	9/19	23°03'N	159°59'W	79.2	050	24	77.3	71.4	1015.2	02	4	8	X	4
4	1215	9/19	23°35'N	159°58'W	77.9	070	16	78.2	73.8	1014.9	02	4	1	9	3
5	1630	9/19	24°13'N	159°54'W	77.8	090	16	75.9	72.8	1015.2	02	4,6	2	9	2
6	1950	9/19	24°12'N	159°59'W	78.0	090	16	77.2	73.5	1012.5	02	4,6	3	9	2
7	0000	9/20	24°44'N	159°56'W	78.4	070	16	78.2	71.7	1013.5	02	4	2	9	2
8	0410	9/20	25°13'N	159°53'W	77.2	055	10	76.3	72.5	1014.2	02	9	1	9	2
9	0625	9/20	25°34'N	159°53'W	76.8	040	17	76.9	73.0	1015.2	02	9	1	9	2
10	0840	9/20	25°34'N	159°55'W	76.9	035	08	75.8	72.2	1015.6	02	X	X	9	2
11	1255	9/20	26°07'N	159°57'W	77.2	070	09	75.2	72.3	1014.6	02	9	1	9	2
12	1645	9/20	26°40'N	160°00'W	77.0	060	10	75.9	69.9	1015.2	02	9	3	8	2
13	1905	9/20	27°01'N	159°59'W	77.8	045	10	77.8	75.0	1015.9	02	8	2	9	2
14	2120	9/20	27°00'N	160°01'W	78.2	045	10	80.5	75.0	1016.6	02	8,6	5	9	2
15	0115	9/21	27°32'N	160°00'W	78.9	050	13	77.7	71.8	1015.2	02	8,6	3	9	2
16	0515	9/21	28°00'N	160°00'W	77.3	040	10	76.2	73.0	1014.2	02	1,8,9	3	X	2
17	0845	9/21	28°29'N	160°00'W	76.8	095	10	75.8	72.8	1016.6	02	X	X	8	2
18	1045	9/21	28°28'N	159°59'W	76.6	calm	calm	75.2	72.0	1017.6	02	X	X	8	1
19	1435	9/21	29°07'N	159°54'W	76.4	030	05	73.7	67.7	1016.9	02	8	1	X	1
20	1850	9/21	29°51'N	159°49'W	75.7	040	07	74.6	72.8	1018.3	02	9,2	2	9	1
21	1955	9/21	30°03'N	159°49'W	76.0	calm	calm	78.9	72.8	1015.9	02	9	1	9	1
22	2210	9/21	30°03'N	159°46'W	77.1	000	01	78.2	71.9	1018.6	02	8	2	9	1
23	0215	9/22	30°35'N	159°47'W	77.2	000	12	78.9	72.6	1016.6	02	8	1	9	1
24	0600	9/22	31°08'N	159°50'W	76.8	000	12	77.4	72.8	1018.3	02	8	2	9	1
25	0855	9/22	31°29'N	159°50'W	75.6	calm	calm	74.5	69.0	1018.3	02	X	X	9	1
26	1115	9/22	31°31'N	159°50'W	75.7	calm	calm	74.0	69.7	1018.3	02	0	0	9	1
27	1510	9/22	32°04'N	159°52'W	75.2	calm	calm	73.6	70.1	1018.0	23	X	X	6	1
28	1915	9/22	32°40'N	159°54'W	77.2	300	06	74.0	71.2	1018.0	01	4,8	1	9	1
29	2045	9/22	32°57'N	159°55'W	76.7	300	06	74.6	72.3	1018.0	02	4,8	1	9	1
30	2245	9/22	32°58'N	159°55'W	75.0	255	09	75.0	73.5	1016.9	03	8,4	6	9	1

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro- meter, mb.	Wea- ther	Clouds		Visi- bili- ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
31	0345	9/23	33°33'N	160°02'W	76.0	270	12	76.5	74.4	1015.6	02	8, 7	7	8	2
32	0615	9/23	34°06'N	160°07'W	75.0	315	07	75.2	72.1	1015.6	02	1, 4, 8	3	9	3
33	0923	9/23	34°29'N	160°08'W	74.1	235	18	74.5	74.0	1013.2	02	X	0	9	3
34	1130	9/23	34°30'N	160°09'W	73.9	280	20	73.9	71.0	1015.2	02	0	0	9	3
35	1530	9/23	35°03'N	160°05'W	74.5	230	18	73.7	70.0	1013.5	02	3, 6, 8	6	6	3
36	1840	9/23	35°34'N	160°02'W	74.1	250	21	75.3	73.6	1013.2	02	8, 3	4	9	4
37	2225	9/23	36°08'N	159°57'W	74.3	260	30	75.3	74.0	1011.9	02	8, 2	7	6	5
38	0400	9/24	36°42'N	159°57'W	74.0	235	30	75.3	75.0	1010.5	02	8, 5	6	6	5
39	0720	9/24	37°09'N	159°59'W	73.4	270	22	74.0	71.8	1008.5	02	X	X	X	5
40	1120	9/24	37°44'N	160°02'W	72.0	300	19	69.5	68.5	1013.2	02	X	9	X	4
41	1435	9/24	38°17'N	160°04'W	70.9	340	14	68.2	63.5	1014.2	02	8	7	X	3
42	1830	9/24	38°54'N	160°06'W	71.5	000	11	68.3	63.8	1015.2	02	4, 5	6	8	3
43	2300	9/24	38°57'N	160°05'W	71.4	065	10	69.1	63.8	1018.0	60	7, 5, 4	9	8	2
44	0400	9/25	39°25'N	160°08'W	70.5	065	24	63.9	61.8	1016.9	61	7	9	7	3
45	0730	9/25	39°51'N	160°11'W	70.1	045	23	65.5	63.3	1018.3	61	X	X	X	3
46	1115	9/25	40°19'N	160°14'W	70.0	040	34	63.3	62.8	1016.9	65	X	9	4	5
47	0045	9/26	41°07'N	160°42'W	67.5	030	35	61.0	59.8	1015.9	60	0	9	4	6
48	1645	9/26	42°02'N	160°17'W	65.1	330	26	62.0	60.2	1014.6	02	0	9	0	5
49	2310	9/26	42°07'N	159°59'W	65.6	345	15	66.1	61.3	1012.5	02	6, 8	4	8	2
50	0510	9/27	42°38'N	160°01'W	64.8	350	10	59.3	58.6	1011.2	50	6, 9	7	7	2
51	0845	9/27	43°09'N	160°01'W	65.3	000	04	62.0	58.5	1011.9	02	8	1	8	2
52	1210	9/27	43°39'N	160°01'W	66.0	150	04	64.8	59.6	1011.5	02	X	0	X	2
53	1425	9/27	43°42'N	160°00'W	65.9	105	14	62.5	58.1	1013.5	02	X	0	8	2
54	1900	9/27	43°21'N	160°00'W	61.5	125	20	63.6	60.8	1010.8	02	1, 2, 3	5	8	2
55	2230	9/27	43°54'N	160°00'W	62.5	135	27	64.8	63.9	1008.5	60	0	9	4	3
56	2300	9/27	43°51'N	160°00'W	62.8	135	27	65.4	64.9	XXXX	XX	X	X	X	X
57	2350	9/27	43°47'N	160°00'W	66.1	135	27	68.2	66.7	1007.8	60	0	8	4	3
58	1915	9/30	44°06'N	160°05'W	61.9	000	XX	64.0	63.5	994.9	03	0, 1, 2	3	8	6
59	2035	9/30	44°36'N	160°12'W	62.0	110	22	64.0	62.3	995.3	15	0, 1, 2, 9	5	7	4
60	2305	9/30	44°58'N	160°12'W	61.0	115	20	63.8	62.0	995.3	02	7, 0	9	7	4

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
61	0230	10/1	44°59'N	160°50'W	61.4	230	05	63.9	62.2	994.2	02	4,8,6	6	7	5
62	0620	10/1	45°00'N	161°30'W	60.4	260	22	60.1	57.2	995.6	26	X	X	4	5
63	0930	10/1	45°01'N	162°09'W	59.9	260	22	59.0	55.2	998.3	01	6,8	4	X	4
64	1300	10/1	45°02'N	162°59'W	60.4	205	18	60.4	57.3	998.3	02	X	X	X	5
65	1235	10/1	45°03'N	163°43'W	59.9	180	18	58.2	57.4	996.6	50	0,8	8	5	4
66	0035	10/2	45°04'N	164°11'W	59.5	280	22	57.2	53.5	993.6	01	2,5,8	2	8	3
67	0400	10/2	45°04'N	164°40'W	58.9	210	26	56.0	53.0	995.3	52	6,9	5	7	4
68	0730	10/2	45°05'N	165°08'W	58.7	250	20	56.6	54.8	997.3	25	8	3	X	4
69	1120	10/2	45°05'N	165°41'W	59.1	230	24	55.7	52.4	996.3	01	8,2	2	8	4
70	1505	10/2	45°05'N	166°17'W	57.0	210	24	52.1	51.5	996.6	52	8,9	5	X	4
71	2335	10/2	45°03'N	166°55'W	57.5	235	30	55.8	51.8	1000.0	02	8	3	8	6
72	0415	10/3	44°50'N	167°27'W	56.3	230	32	55.0	51.3	1002.7	02	0,8	7	7	5
73	1110	10/3	44°38'N	167°56'W	56.5	230	29	54.8	52.7	1003.4	02	X	8	7	5
74	1715	10/3	44°26'N	168°25'W	56.0	210	28	55.0	53.2	1005.1	15	6,9	8	7	4
75	2100	10/3	44°17'N	168°48'W	56.1	212	28	56.2	54.3	1007.5	02	0,9	8	7	4
76	0100	10/4	44°05'N	169°20'W	56.2	245	18	59.0	55.8	1007.1	02	1,6,8	6	7	5
77	0430	10/4	43°48'N	169°43'W	57.0	330	03	56.9	55.0	1005.4	02	8,9	8	7	3
78	1040	10/4	43°15'N	169°47'W	57.0	210	07	58.2	56.1	1009.1	02	0	8	7	1
79	1400	10/4	42°44'N	169°50'W	58.7	160	10	58.3	57.2	1010.8	02	X	8	X	2
80	1750	10/4	42°14'N	169°53'W	59.1	140	13	60.2	59.6	1012.5	50	0	8	6	2
81	2330	10/4	41°48'N	169°51'W	59.8	180	22	61.7	61.9	1014.6	47	X	X	0	2
82	0300	10/5	41°24'N	169°49'W	61.5	185	19	63.9	63.2	1013.9	01	X	0	9	3
83	0645	10/5	41°00'N	169°47'W	61.5	210	22	63.5	62.5	1013.2	02	X	X	9	3
84	1235	10/5	40°37'N	169°47'W	61.7	160	25	64.5	63.6	1011.2	02	X	6	X	4
85	1815	10/5	40°10'N	169°45'W	65.1	210	30	66.0	65.0	1009.5	02	0	8	9	5
86	2300	10/5	39°42'N	169°43'W	64.8	200	22	67.8	66.0	1011.2	02	0,2	6	9	4
87	0300	10/6	39°13'N	169°49'W	65.1	200	13	67.6	66.1	1012.2	02	4	1	9	4
88	0730	10/6	38°41'N	169°57'W	64.9	200	05	66.0	65.0	1013.5	02	0	0	9	2
89	1345	10/6	38°10'N	170°01'W	64.9	190	05	64.8	64.5	1013.5	28	X	X	3	1
90	1715	10/6	37°42'N	170°04'W	64.6	230	03	64.3	64.3	1014.2	44	X	8	0	1

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
91	0445	10/7	37°07'N	170°05'W	68.9	000	00	68.5	68.0	1012.5	28	X	9	3	1
92	1030	10/7	36°34'N	170°05'W	68.0	180	26	71.7	70.0	1012.5	00	X	X	X	4
93	1400	10/7	36°06'N	170°06'W	70.5	160	26	72.0	70.5	1012.9	00	X	X	X	4
94	1910	10/7	35°29'N	170°07'W	70.0	210	27	72.2	70.0	1014.9	02	8	5	X	4
95	2235	10/7	35°00'N	170°07'W	70.3	210	25	73.6	71.0	1015.2	03	8, 6	7	8	4
96	0230	10/8	34°34'N	170°09'W	72.1	210	21	74.5	72.1	1015.2	02	8, 6	6	9	4
97	0550	10/8	34°07'N	170°12'W	72.2	190	19	74.0	72.0	1016.3	02	2, 6	3	9	3
98	0750	10/8	34°04'N	170°12'W	72.4	190	18	74.3	72.0	1017.6	02	2, 6	3	9	3
99	1130	10/8	33°35'N	170°13'W	72.0	195	19	73.8	72.0	1018.6	03	7, 2	6	9	3
100	1510	10/8	33°06'N	170°15'W	72.9	190	15	74.8	72.4	1019.0	02	X	0	9	2
101	1920	10/8	32°29'N	170°18'W	73.8	220	08	75.8	73.3	1022.4	02	8	1	9	1
102	0100	10/9	32°02'N	170°15'W	74.9	160	11	77.0	73.9	1022.0	02	8	1	9	2
103	0400	10/9	31°36'N	170°12'W	75.0	180	14	76.1	73.9	1024.0	02	X	0	9	2
104	1100	10/9	30°45'N	170°10'W	75.2	150	15	76.4	74.0	1025.4	01	4	1	9	2
105	1415	10/9	30°17'N	170°10'W	76.7	180	16	77.0	74.2	1024.4	02	2, 8	2	9	2
106	1615	10/9	30°00'N	170°10'W	76.4	090	08	77.0	74.0	1025.1	02	8	1	9	1
107	2205	10/9	29°55'N	170°51'W	76.8	130	10	81.0	74.6	1027.4	02	8	2	7	2
108	0130	10/10	29°50'N	171°30'W	77.9	220	04	82.4	75.6	1026.1	02	8, 4	2	9	2
109	0515	10/10	29°45'N	172°05'W	77.3	110	12	77.7	73.0	1026.4	02	8, 2	1	9	2
110	1030	10/10	29°36'N	172°38'W	77.0	050	12	78.0	74.1	1028.1	02	8	1	9	2
111	1350	10/10	29°28'N	173°10'W	76.3	150	05	79.2	74.5	1026.4	02	8	3	9	2
112	1745	10/10	29°17'N	173°54'W	76.6	090	12	78.2	72.5	1029.8	02	8	2	9	2
113	2340	10/10	29°04'N	174°34'W	77.0	070	16	80.1	72.5	1025.7	02	8	2	8	3
114	0815	10/15	28°47'N	178°18'W	77.3	090	10	76.0	73.2	1021.0	02	0	6	8	2
115	1050	10/15	28°47'N	178°18'W	77.4	090	08	76.0	72.8	1021.0	02	0	6	8	1
116	1430	10/15	29°03'N	178°45'W	76.7	080	14	76.0	72.8	1020.3	02	0	6	8	1
117	1800	10/15	29°25'N	179°10'W	76.3	060	05	75.5	68.8	1021.3	02	6	1	8	1
118	2120	10/15	29°34'N	179°42'W	77.4	000	00	78.3	73.1	1020.7	02	X	0	8	1
119	0145	10/16	29°51'N	179°45'E	76.9	150	05	81.8	73.3	1019.6	02	8	1	8	1
120	0545	10/16	30°18'N	179°45'E	76.8	000	00	77.9	74.8	1019.3	02	0	7	8	1

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
121	0850	10/16	30°45'N	179°42'E	76.1	000	00	76.9	71.7	1020.0	02	8	3	8	1
122	1345	10/16	31°30'N	179°37'E	74.9	180	04	75.2	72.0	1020.0	02	8	2	8	1
123	1915	10/16	32°08'N	179°40'E	75.0	000	12	72.5	71.0	1021.0	51	1, 9	7	7	2
124	2200	10/16	32°29'N	179°47'E	74.6	065	07	75.3	72.0	1020.7	01	8, 2	3	8	2
125	0150	10/17	32°59'N	179°58'E	73.8	080	22	75.3	70.5	1020.3	02	8, 2	3	8	2
126	0715	10/17	33°30'N	179°53'E	72.2	105	16	71.8	67.7	1022.4	03	5, 8	4	8	2
127	1035	10/17	33°59'N	179°49'E	71.0	080	18	70.0	66.0	1022.0	02	5, 8	4	X	3
128	1400	10/17	34°30'N	179°52'E	71.3	115	18	70.0	66.8	1021.0	02	8	3	8	2
129	1915	10/17	35°03'N	179°54'E	69.2	160	18	70.0	67.5	1020.0	02	6	8	8	2
130	2250	10/17	35°28'N	179°57'E	69.8	160	15	70.8	69.5	1017.3	02	0, 5	8	8	2
131	0250	10/18	36°02'N	179°58'E	68.8	185	22	71.8	69.3	1012.5	01	2, 5	8	8	3
132	0815	10/18	36°35'N	179°59'E	65.6	180	33	70.9	68.5	1009.1	02	X	7	X	4
133	2020	10/19	36°33'N	179°32'W	64.7	045	26	60.0	64.7	1026.4	02	8	6	8	5
134	0030	10/20	37°02'N	179°37'W	63.0	060	20	59.8	53.5	1026.4	02	1, 8	4	8	4
135	0430	10/20	37°21'N	179°42'W	63.8	060	21	60.0	52.2	1028.8	02	1, 8	4	8	4
136	0850	10/20	37°55'N	179°53'W	63.5	065	17	57.8	56.7	1030.1	02	X	X	8	4
137	1145	10/20	38°17'N	180°00'	58.4	070	10	55.7	50.3	1030.5	02	X	9	5	3
138	1300	10/20	38°30'N	179°56'E	58.7	000	10	55.0	48.0	1030.8	01	6	5	5	3
139	1700	10/20	39°04'N	179°46'E	59.7	075	06	55.3	48.7	1030.5	01	6	7	8	2
140	2000	10/20	39°28'N	179°38'E	58.9	135	12	55.7	54.1	1030.5	02	2, 5, 8	7	8	2
141	0040	10/21	39°45'N	179°38'E	59.1	175	20	58.1	52.3	1029.5	02	2, 5, 8	2	8	2
142	0320	10/21	40°10'N	179°38'E	58.0	180	24	57.0	52.3	1022.4	02	1, 3, 4, 8	6	8	4
143	0600	10/21	40°35'N	179°38'E	57.2	170	27	59.2	54.4	1020.3	02	5, 6	9	8	4
144	0920	10/21	41°12'N	179°38'E	57.5	170	34	58.1	56.2	1012.5	65	X	X	1	5
145	1830	10/22	42°09'N	179°50'E	55.9	310	38	50.8	47.7	1016.6	02	8	2	8	5
146	0000	10/23	42°31'N	179°49'E	53.0	350	22	50.0	45.0	1015.6	03	6, 9	9	8	5
147	0600	10/23	43°19'N	179°49'E	51.1	310	10	47.2	42.2	1014.6	02	4, 8	9	8	2
148	1120	10/23	43°59'N	179°47'E	49.1	270	08	47.2	46.5	1011.5	02	X	X	8	2
149	1500	10/23	44°31'N	179°46'E	47.3	310	15	46.9	43.8	1009.1	02	X	X	8	2
150	1900	10/23	45°00'N	179°42'E	48.5	250	22	45.5	41.2	1008.5	02	6, 4, 8	7	8	3

Table 2.--Summary of observations at bathythermograph lowerings, *Charles H. Gilbert* cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
151	2035	10/23	45°00'N	179°27'E	49.0	250	25	46.0	42.2	1010.2	02	6,9	7	7	3
152	0300	10/24	44°57'N	178°58'E	48.6	030	40	45.8	42.5	1011.5	02	8	6	8	4
153	1040	10/24	45°00'N	177°58'E	48.1	350	24	44.0	41.9	1019.3	02	X	X	8	5
154	1435	10/24	44°56'N	177°11'E	48.2	350	28	45.2	40.5	1019.6	02	X	7	7	4
155	1830	10/24	44°56'N	176°32'E	47.2	030	28	45.6	41.9	1023.4	02	5,8	9	8	4
156	2220	10/24	44°57'N	175°47'E	47.0	340	14	45.9	42.0	1024.0	02	6,4,8	6	8	3
157	0435	10/25	44°58'N	175°02'E	48.9	185	19	48.4	45.1	1021.0	02	6,8	7	8	2
158	0805	10/25	44°58'N	174°25'E	50.3	190	18	48.7	44.3	1015.9	02	X	8	7	3
159	1150	10/25	44°58'N	173°43'E	49.7	145	34	48.0	46.0	1008.5	53	X	9	X	4
160	1620	10/25	45°00'N	172°33'E	48.7	285	25	49.1	47.3	993.9	53	X	X	X	4
160A	1940	10/25	44°59'N	171°46'E	49.9	285	27	49.1	47.3	988.8	02	4,8	2	8	4
161	2045	10/26	42°18'N	172°07'E	52.8	330	19	49.0	44.5	1017.3	02	0	8	7	4
162	0300	10/27	41°36'N	172°14'E	52.2	330	22	52.1	48.0	1016.3	02	0	7	7	4
163	0630	10/27	41°12'N	172°17'E	55.1	300	24	53.0	47.1	1016.3	02	6	8	7	4
164	0935	10/27	40°45'N	172°13'E	59.7	300	32	55.7	50.0	1016.9	02	6	8	7	4
165	1235	10/27	40°18'N	172°09'E	58.9	270	30	55.2	49.8	1017.6	02	X	X	7	4
166	1535	10/27	39°51'N	172°05'E	59.2	285	30	55.0	49.8	1018.3	02	X	X	7	4
167	1835	10/27	39°23'N	172°01'E	62.6	300	27	58.4	51.8	1019.0	02	4,8	9	8	4
168	2130	10/27	38°56'N	171°57'E	59.8	290	20	56.2	53.2	1020.7	02	4,8	8	8	4
169	0030	10/28	38°27'N	171°53'E	63.6	300	28	59.0	53.9	1020.3	01	4,8	4	8	4
170	0340	10/28	38°01'N	171°50'E	63.4	305	16	60.0	55.0	1020.3	02	8	4	8	5
171	0630	10/28	37°34'N	171°46'E	64.0	310	22	60.0	54.4	1020.3	02	6	8	8	4
172	0930	10/28	37°08'N	171°42'E	64.6	310	20	60.3	55.4	1021.7	02	X	8	8	3
173	1230	10/28	36°40'N	171°38'E	65.7	000	14	60.2	55.0	1021.7	02	X	X	8	3
174	1530	10/28	36°13'N	171°36'E	70.3	010	15	65.0	59.0	1021.7	02	X	X	8	2
175	1830	10/28	35°45'N	171°32'E	68.5	060	07	63.7	57.3	1021.0	02	0	8	8	2
176	0035	10/29	35°09'N	171°32'E	70.0	130	13	66.0	60.5	1019.3	60	0	8	5	3
177	0400	10/29	34°33'N	171°32'E	68.7	090	21	72.0	59.6	1018.6	02	8	8	7	3
178	0730	10/29	34°01'N	171°31'E	70.3	125	25	67.5	61.9	1018.3	02	1	1	7	4
179	1130	10/29	33°32'N	171°30'E	72.2	166	27	66.0	63.2	1017.6	60	X	X	2	4

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
180	1500	10/29	33°02'N	171°30'E	71.5	150	28	70.0	66.0	1016.3	02	X	8	X	4
181	1830	10/29	32°32'N	171°29'E	72.6	190	23	71.0	68.5	1016.6	50	0	9	3	4
182	2200	10/29	32°03'N	171°28'E	73.4	160	21	74.5	71.2	1017.6	02	0	9	4	4
183	0130	10/30	31°34'N	171°30'E	73.3	150	19	76.0	72.0	1015.6	02	6, 8, 1	7	8	4
184	0500	10/30	31°23'N	172°01'E	73.3	170	18	73.8	71.2	1016.3	02	1, 3, 8	6	8	4
185	1100	10/30	31°15'N	172°39'E	72.6	130	04	74.5	71.5	1017.6	02	X	X	8	3
186	1430	10/30	31°07'N	173°15'E	72.4	130	10	75.0	72.0	1015.6	02	X	X	3	2
187	1800	10/30	30°59'N	173°52'E	75.3	200	14	74.8	72.3	1016.6	60	0, 5	8	6	3
188	0000	10/31	30°50'N	174°32'E	75.9	170	20	77.0	73.5	1015.9	02	6, 5	7	8	3
189	0330	10/31	30°33'N	175°04'E	76.0	190	13	77.8	73.6	1014.9	02	5, 6	7	7	3
190	0700	10/31	30°15'N	175°36'E	76.2	190	14	77.0	73.2	1016.3	02	X	X	7	2
191	1305	10/31	30°04'N	176°10'E	77.6	145	16	77.0	73.9	1015.6	02	X	X	7	2
192	1630	10/31	29°53'N	176°43'E	78.2	200	12	76.0	71.6	1015.6	02	8	2	8	3
193	2010	10/31	29°39'N	177°19'E	77.8	205	18	77.8	72.1	1016.6	02	5	1	8	3
194	0130	11/1	29°23'N	177°49'E	74.4	185	14	76.2	70.6	1014.9	03	5	1	8	3
195	0505	11/1	29°08'N	178°22'E	74.8	220	11	75.8	70.5	1014.9	02	5	1	8	2
196	0755	11/1	28°55'N	178°50'E	74.9	220	13	75.6	70.0	1015.6	02	5	1	8	2
197	1300	11/1	28°40'N	179°20'E	75.8	190	16	75.3	70.5	1015.9	02	X	1	8	3
198	1600	11/1	28°26'N	179°47'E	75.3	200	05	75.0	69.5	1015.2	02	8	1	8	2
199	1900	11/1	28°11'N	179°43'W	75.1	260	10	75.1	69.7	1016.3	02	8	1	8	1
200	2330	11/1	28°03'N	179°10'W	77.0	250	11	77.9	71.1	1014.9	02	2, 8	1	8	1
201	0200	11/2	27°56'N	178°47'W	77.2	250	08	79.2	74.0	1015.2	02	5, 8	1	8	2
202	0430	11/2	27°49'N	178°22'W	77.4	270	10	77.7	71.9	1013.9	02	1, 8	2	8	2
203	0700	11/2	27°42'N	177°56'W	77.0	285	05	77.7	72.1	1014.9	02	8	2	8	1
204	0930	11/2	27°35'N	177°30'W	77.7	250	04	76.8	71.7	1014.9	02	8	2	8	1
205	1200	11/2	27°28'N	177°06'W	76.3	250	08	76.0	70.2	1015.6	02	X	1	8	2
206	1430	11/2	27°22'N	176°40'W	77.6	275	07	75.8	70.1	1013.9	02	X	1	8	1
207	1700	11/2	27°14'N	176°12'W	78.0	288	05	76.0	71.8	1014.2	02	8	2	8	1
208	1935	11/2	27°08'N	175°47'W	77.3	260	05	77.5	72.3	1015.6	02	1, 8	1	8	1
209	2200	11/2	27°02'N	175°27'W	77.5	250	10	78.0	72.0	1015.9	02	1, 8	3	8	3

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
210	0030	11/3	26°53'N	175°02'W	77.6	260	07	79.9	74.7	1013.5	02	1, 8	4	8	2
211	0300	11/3	26°46'N	174°36'W	77.8	285	12	78.1	73.0	1012.9	01	1, 8	1	8	1
212	0530	11/3	26°37'N	174°10'W	76.7	290	10	79.8	75.4	1013.5	02	1, 8	1	8	2
213	0800	11/3	26°29'N	173°45'W	75.1	290	02	77.1	72.0	1016.3	02	1, 8	3	8	1
214	1030	11/3	26°21'N	173°21'W	75.3	245	04	75.7	72.8	1014.9	02	1, 8	1	8	1
215	1300	11/3	26°14'N	172°57'W	77.2	245	06	75.2	72.0	1014.2	02	1, 8	1	8	1
216	1530	11/3	26°04'N	172°34'W	78.9	285	09	77.3	72.0	1013.5	02	X	X	8	2
217	1800	11/3	25°55'N	172°09'W	78.5	340	12	76.0	72.6	1015.6	16	8, 9	8	7	2
218	0500	11/4	25°40'N	171°38'W	78.3	065	15	78.0	72.3	1013.9	01	2, 8	6	7	3
219	0730	11/4	25°27'N	171°16'W	78.1	095	14	78.0	73.2	1014.9	01	1, 5, 8	7	7	2
220	1000	11/4	25°13'N	170°54'W	79.0	060	12	74.7	73.2	1016.3	63	0	8	3	2
221	1230	11/4	24°59'N	170°33'W	79.0	030	10	75.0	72.4	1015.6	02	X	8	7	2
222	1500	11/4	24°49'N	170°12'W	78.8	010	05	76.7	73.3	1014.9	02	1, 8	8	7	2
223	1730	11/4	24°39'N	169°50'W	78.4	170	06	74.1	73.0	1015.9	58	1	9	5	1
224	2000	11/4	24°29'N	169°28'W	78.2	230	04	75.2	73.5	1016.9	02	1	7	8	2
225	2230	11/4	24°18'N	169°06'W	79.0	200	05	79.0	72.9	1015.9	02	0, 3, 1, 5	2	8	1
226	0100	11/5	24°09'N	168°44'W	79.5	210	08	78.0	72.6	1015.6	02	0, 3, 1, 5	2	8	1
227	0330	11/5	23°59'N	168°21'W	79.9	235	07	80.0	73.0	1016.9	02	1, 5, 8	1	8	1
228	0600	11/5	23°49'N	167°57'W	78.8	000	00	77.6	71.2	1016.6	02	1, 8	1	8	1
229	0830	11/5	23°40'N	167°34'W	78.4	000	00	76.8	70.1	1017.6	02	8	1	8	0
230	1100	11/5	23°33'N	167°10'W	78.8	100	02	76.9	70.5	1016.9	02	8	1	8	0
231	1330	11/5	23°26'N	166°43'W	78.0	135	05	76.9	71.5	1014.9	02	5	1	8	0
232	1600	11/5	23°20'N	166°18'W	78.4	160	03	76.2	71.5	1015.6	02	8	1	8	0
233	1830	11/5	23°14'N	165°54'W	78.1	090	10	78.1	70.7	1016.9	02	6, 8	1	8	1
234	2100	11/5	23°08'N	165°29'W	78.6	105	03	80.7	73.6	1017.3	02	6, 8	1	8	1
235	2330	11/5	23°01'N	165°02'W	79.9	105	05	81.7	75.4	1015.6	03	0, 4, 5, 8	7	8	0
236	0200	11/6	22°54'N	164°37'W	79.4	095	07	77.1	74.8	1015.2	02	8	1	8	0
237	0430	11/6	22°49'N	164°18'W	78.5	060	06	76.0	70.6	1016.3	02	8	1	8	1
238	0700	11/6	22°44'N	163°55'W	78.4	040	07	77.8	73.6	1017.3	01	X	0	8	0
239	0930	11/6	22°37'N	163°30'W	78.0	094	11	77.8	74.0	1020.0	03	4, 5, 8	1	8	1

Table 2.--Summary of observations at bathythermograph lowerings, Charles H. Gilbert cruise 17, September 17 to November 7, 1954 (For coded values see H. O. Pub. 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1954	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
240	1200	11/6	22°31'N	163°07'W	77.9	095	07	78.1	73.0	1016.6	02	8	1	8	1
241	1430	11/6	22°25'N	162°44'W	78.1	060	10	77.0	71.0	1016.6	02	8	1	8	2
242	1700	11/6	22°20'N	162°20'W	78.9	040	18	83.2	78.6	1016.9	03	4, 5, 8	3	8	3
243	1930	11/6	22°14'N	161°55'W	79.2	090	17	78.3	75.5	1017.6	15	4, 5, 8, 9	5	8	2
244	2200	11/6	22°07'N	161°32'W	79.9	065	16	81.9	76.3	1016.9	02	8	3	8	1
245	0030	11/7	22°02'N	161°09'W	80.0	060	14	79.5	72.0	1015.2	02	8	1	8	3
246	0300	11/7	21°56'N	160°48'W	79.8	065	17	80.7	73.9	1014.9	02	8	1	8	3
247	0530	11/7	21°50'N	160°25'W	79.3	055	20	78.6	74.0	1016.3	03	4, 5, 8	2	8	2
248	0800	11/7	21°43'N	160°03'W	78.4	070	22	77.8	74.1	1017.3	02	8	2	8	2
249	1030	11/7	21°37'N	159°40'W	78.9	070	25	79.8	71.2	1016.9	03	8	3	8	3-4
250	1300	11/7	21°33'N	159°18'W	78.9	060	22	77.3	72.5	1015.9	03	8	3	8	3
251	1530	11/7	21°29'N	158°58'W	79.2	052	21	77.6	75.2	1016.3	02	8	1	8	3
252	1800	11/7	21°23'N	158°35'W	79.9	055	19	80.8	75.1	1017.3	02	8	3	8	3

Table 3.--Log of ship's weather observations, Charles H. Gilbert cruise 17, September 17 to November 7, 1954. Results in International Ship's Weather Code, January 1954

Date, 1954	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
9/19	22.9°N	160.0°W	0600	99	07	26	02	1	1014.6	3	1.0	78.0	70.4	78.6	X	X	X	X	X	X	07	4	4
9/19	23.7°N	160.0°W	1200	99	07	16	02	1	1014.9	8	1.0	78.2	73.8	77.9	1	1	1	6	0	0	07	3	3
9/20	24.7°N	160.0°W	0000	99	07	16	02	1	1013.5	8	1.0	78.2	71.7	78.4	2	2	2	6	0	0	07	2	1
9/20	25.3°N	160.0°W	0600	99	04	17	02	1	1014.6	3	1.2	75.2	69.8	77.2	1	1	8	7	4	0	04	2	2
9/20	25.8°N	160.0°W	1200	99	04	10	02	1	1014.9	8	0.6	76.0	72.8	76.9	1	1	2	7	0	0	04	2	1
9/20	26.8°N	160.0°W	1800	99	06	10	02	1	1015.2	3	1.2	75.9	69.9	77.0	3	3	2	6	0	0	06	2	2
9/21	27.2°N	160.0°W	0000	97	05	16	16	1	1015.9	8	0.6	74.8	71.2	78.5	7	5	6	6	0	2	05	3	2
9/21	28.3°N	160.0°W	0600	98	04	10	02	1	1014.2	3	1.6	76.2	73.0	77.3	4	3	2	5	0	2	04	2	1
9/21	28.6°N	160.0°W	1200	98	00	00	02	1	1017.6	8	0.8	75.2	72.0	76.6	X	X	X	X	X	X	09	2	0
9/21	29.8°N	160.0°W	1800	99	06	09	02	1	1018.0	3	0.8	74.7	70.8	75.6	2	1	1	5	0	9	03	3	1
9/22	30.4°N	160.0°W	0000	99	02	08	02	1	1018.0	0	0.6	77.2	71.0	77.8	2	2	5	5	0	0	03	3	2
9/22	31.2°N	160.0°W	0600	-	02	08	02	1	1018.3	3	1.4	77.4	72.8	76.8	3	3	8	6	0	0	03	3	2
9/22	31.6°N	160.0°W	1200	99	00	00	02	1	1018.3	8	0.3	74.0	69.7	75.7	0	0	0	9	0	0	03	2	1
9/22	32.5°N	160.0°W	1800	99	31	12	15	6	1018.0	3	0.0	72.4	69.3	75.3	4	2	3	6	6	0	33	2	2
9/23	33.2°N	160.0°W	0000	99	26	09	03	1	1016.9	8	1.2	75.0	73.5	75.0	4	2	8	5	2	0	30	2	2
9/23	34.1°N	160.0°W	0600	99	31	07	02	1	1014.9	8	0.8	75.2	72.1	75.0	3	2	2	5	6	1	32	3	3
9/23	34.6°N	160.0°W	1200	98	28	20	02	0	1015.2	9	1.0	73.9	71.0	73.9	0	0	0	9	0	0	28	3	3
9/23	35.4°N	160.0°W	1800	99	25	20	02	1	1013.5	6	0.3	74.3	71.1	73.9	3	3	2	5	3	1	26	3	3
9/24	37.0°N	160.0°W	0600	97	34	30	02	2	1010.8	5	0.4	75.3	75.0	74.0	5	5	7	5	0	0	34	3	7
9/24	37.9°N	160.0°W	1200	97	30	19	02	2	1012.5	3	2.0	69.5	68.5	72.0	9	9	X	0	X	X	34	3	4
9/24	38.9°N	160.0°W	1800	98	00	11	02	1	1015.2	5	1.7	68.3	63.8	71.5	7	0	0	9	7	0	26	4	3
9/25	39.1°N	160.0°W	0000	98	07	14	60	2	1017.6	1	0.6	69.1	63.8	71.4	8	6	6	4	2	X	24	3	5
9/25	39.7°N	160.2°W	0600	97	04	21	63	2	1016.6	1	0.8	66.0	62.2	70.2	8	7	3	4	2	X	04	2	5
9/25	40.6°N	160.3°W	1200	95	04	34	65	6	1016.9	9	1.0	63.3	62.8	70.0	9	9	X	0	X	X	04	3	6
9/25	40.8°N	160.7°W	1800	97	04	34	60	6	1016.6	4	0.8	61.5	59.4	69.5	8	8	7	4	X	X	04	4	6
9/26	41.0°N	160.7°W	0000	97	03	35	60	6	1015.9	8	1.4	61.0	59.8	67.5	8	8	7	4	X	X	03	4	9
9/26	41.6°N	160.6°W	0600	96	03	35	21	6	1015.9	5	0.0	62.0	59.8	67.0	8	8	7	4	X	X	03	4	9
9/26	42.0°N	160.0°W	1200	95	03	29	65	6	1014.9	6	2.0	59.5	59.0	66.5	9	9	X	0	X	X	03	4	7
9/26	42.0°N	160.2°W	1800	98	33	26	02	2	1014.6	0	0.0	62.0	60.2	65.1	8	8	7	4	X	X	01	4	7
9/27	42.0°N	160.0°W	0000	98	27	18	02	2	1012.5	6	2.1	66.1	61.3	65.6	6	6	4	5	0	0	29	3	5

Table 3.--Log of ship's weather observations, Charles H. Gilbert cruise 17, September 17 to November 7, 1954. Results in International Ship's Weather Code, January 1954 (cont'd)

Date, 1954	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
9/27	42.8°N	160.0°W	0600	97	35	10	50	1	1011.2	3	1.0	59.3	58.6	64.8	7	7	3	4	0	0	02	2	3
9/27	43.6°N	160.0°W	1200	-	15	04	02	0	1011.5	6	0.1	64.8	59.6	66.0	0	0	0	9	0	0	20	2	2
9/28	44.0°N	160.0°W	0000	98	14	27	21	6	1007.8	6	2.0	68.2	66.7	66.1	8	6	7	4	5	2	14	4	4
9/28	44.1°N	160.0°W	0600	98	14	34	02	2	1007.8	4	1.0	68.5	67.5	65.5	8	2	7	4	5	2	15	4	9
9/28	44.3°N	160.0°W	1800	98	14	26	02	2	1008.8	4	1.0	68.0	66.3	64.8	8	9	2	4	5	2	14	4	8
9/29	43.0°N	160.0°W	0000	98	15	38	02	2	1005.8	8	2.0	68.2	67.5	64.8	8	0	0	9	2	X	65	5	1
9/29	42.8°N	160.0°W	0600	97	14	39	02	2	1002.7	8	1.0	67.3	68.5	66.0	8	8	0	6	2	X	67	8	3
9/29	42.8°N	159.8°W	1800	94	14	34	02	2	997.6	5	0.7	65.2	64.7	65.5	8	8	7	3	X	X	65	5	4
9/30	43.2°N	159.8°W	0000	95	15	22	21	6	995.9	9	1.1	64.5	63.4	64.2	8	8	9	3	X	X	15	6	9
9/30	43.5°N	159.9°W	0600	96	14	20	62	1	996.3	3	0.0	65.1	64.9	65.0	6	4	7	4	8	6	14	5	9
9/30	44.1°N	160.0°W	1200	99	11	17	02	2	994.9	5	0.0	64.0	63.5	61.9	3	2	2	3	0	2	11	6	9
10/1	45.0°N	160.2°W	0000	98	12	20	02	2	961.4	3	0.0	63.8	62.0	61.0	8	2	3	4	2	X	62	8	0
10/1	45.0°N	161.5°W	0600	95	26	22	36	8	995.6	3	2.0	60.1	57.2	60.4	8	8	2	4	X	X	11	7	9
10/1	45.0°N	162.6°W	1200	98	23	21	01	1	998.6	1	0.6	59.9	55.9	60.0	2	2	1	5	0	0	23	4	6
10/1	45.0°N	163.6°W	1800	96	18	18	21	2	996.6	8	1.3	58.2	57.4	59.9	8	8	7	4	X	X	XX	X	X
10/2	45.0°N	164.3°W	0000	99	28	22	01	1	993.6	3	0.0	57.2	53.5	59.5	2	1	2	5	6	1	28	3	3
10/2	45.0°N	165.0°W	0600	98	22	26	02	1	995.9	3	2.0	57.5	53.0	58.8	4	3	5	6	2	0	22	3	6
10/2	45.0°N	165.9°W	1200	99	23	24	01	1	996.3	6	0.3	55.7	52.4	59.1	2	2	3	6	0	2	24	3	5
10/2	45.0°N	166.4°W	1800	99	27	36	62	1	998.3	4	1.3	52.2	50.2	57.3	3	2	2	6	0	2	27	5	7
10/3	45.0°N	166.8°W	0000	99	24	30	02	1	1000.0	3	1.7	55.8	51.8	57.5	3	3	4	6	0	0	24	3	8
10/3	44.8°N	167.5°W	0600	98	23	32	02	1	1002.7	3	2.7	55.0	51.3	56.3	7	7	4	5	0	0	24	3	7
10/3	44.6°N	168.0°W	1200	98	23	29	02	2	1003.4	3	0.0	54.8	52.7	56.5	X	X	X	X	X	X	23	3	7
10/3	44.4°N	168.5°W	1800	98	21	28	15	2	1005.1	3	1.6	55.0	53.2	56.0	8	8	4	4	X	X	21	3	6
10/4	44.1°N	169.2°W	0000	98	24	18	02	2	1006.8	0	1.7	59.0	55.8	56.2	6	5	4	4	4	1	24	3	7
10/4	43.6°N	169.7°W	0600	98	33	03	02	2	1005.4	6	0.2	56.9	55.0	57.0	8	4	4	4	6	X	28	3	5
10/4	43.1°N	169.9°W	1200	98	22	07	02	2	1009.1	3	2.0	58.2	56.1	57.0	8	8	6	4	X	X	27	2	1
10/4	42.3°N	170.0°W	1800	97	14	13	50	2	1012.5	3	1.6	60.2	59.6	59.1	8	8	6	4	X	X	24	2	2
10/5	41.6°N	170.0°W	0000	90	18	22	47	4	1014.6	3	1.0	61.7	61.9	59.8	X	X	X	X	X	X	23	3	6
10/5	41.0°N	169.8°W	0600	99	17	20	02	4	1013.9	3	0.0	63.0	62.7	60.0	1	0	0	9	7	1	19	2	3
10/5	40.6°N	169.8°W	1200	90	16	25	02	2	1011.2	6	1.8	64.8	63.6	61.7	6	X	X	X	X	X	16	3	6

Table 3.--Log of ship's weather observations, Charles H. Gilbert cruise 17, September 17 to November 7, 1954. Results in International Ship's Weather Code, January 1954 (cont'd)

Date, 1954	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
10/5	40.0°N	169.9°W	1800	99	21	30	02	2	1009.5	1	1.1	66.0	65.0	65.1	8	8	7	4	X	X	21	3	5
10/6	39.6°N	170.0°W	0000	99	20	22	02	2	1011.2	2	0.6	67.8	66.0	64.8	7	0	0	9	0	8	21	2	7
10/6	38.8°N	170.0°W	0600	99	20	05	02	0	1013.5	3	1.2	66.0	65.0	64.9	1	0	0	9	3	0	19	2	3
10/6	38.4°N	170.0°W	1200	99	19	04	02	0	1013.9	0	0.0	64.8	63.9	64.7	X	X	X	X	X	X	19	2	1
10/6	37.7°N	170.0°W	1800	90	23	03	44	4	1014.2	3	0.6	64.3	64.3	64.6	8	X	X	X	X	X	23	3	3
10/7	37.7°N	170.0°W	0000	96	23	06	46	1	1014.6	8	1.0	65.0	65.0	65.4	7	0	0	9	0	7	23	3	3
10/7	37.1°N	170.1°W	0600	94	00	00	28	4	1012.5	4	0.3	68.5	68.0	69.9	9	9	X	0	X	X	21	2	0
10/7	36.4°N	170.1°W	1200	-	18	26	00	4	1012.5	0	0.0	71.7	70.0	68.0	0	0	0	9	0	0	20	3	4
10/7	35.6°N	170.1°W	1800	99	21	27	02	1	1014.9	4	1.3	72.2	70.0	70.0	5	5	1	4	0	0	21	3	3
10/8	34.8°N	170.1°W	0000	98	21	25	03	1	1015.2	3	0.2	73.6	71.0	70.3	7	7	3	X	0	0	21	3	4
10/8	34.1°N	170.2°W	0600	99	19	19	02	1	1016.3	3	1.3	74.0	72.0	72.2	3	2	5	4	0	8	19	2	2
10/8	33.5°N	170.2°W	1200	98	19	19	03	1	1018.6	3	0.8	73.8	72.0	72.0	5	2	3	5	2	3	19	2	3
10/8	32.7°N	170.3°W	1800	99	22	08	02	1	1022.4	3	2.7	75.8	73.3	73.8	1	1	1	4	0	0	22	2	1
10/9	32.1°N	170.3°W	0000	99	17	11	02	0	1022.7	8	1.0	77.0	73.9	74.9	1	1	8	X	0	0	25	4	3
10/9	31.2°N	170.2°W	0600	99	18	14	02	0	1024.0	4	2.0	76.1	73.9	75.0	0	0	0	9	0	0	22	3	2
10/9	30.6°N	170.2°W	1200	99	15	15	01	0	1025.4	3	0.0	76.4	74.0	75.2	1	0	0	9	3	0	16	3	2
10/9	30.0°N	170.2°W	1800	99	09	08	02	0	1025.7	3	2.0	77.0	74.0	76.4	1	1	1	4	0	0	09	2	0
10/10	29.9°N	171.2°W	0000	99	13	10	02	0	1027.4	0	0.6	81.0	74.6	76.8	1	1	8	4	0	0	18	3	3
10/10	29.7°N	172.1°W	0600	99	11	12	02	0	1026.4	3	1.1	77.3	73.0	77.3	1	1	2	4	0	1	13	3	2
10/10	29.5°N	172.9°W	1200	99	05	12	02	0	1028.1	3	0.0	78.0	74.1	77.0	1	1	1	4	0	0	05	3	2
10/10	29.3°N	173.9°W	1800	99	09	12	02	0	1029.8	3	1.0	78.2	72.5	76.6	1	1	1	4	0	0	10	4	2
10/11	28.8°N	175.5°W	0600	99	11	12	02	0	1024.4	5	0.6	81.3	73.9	78.0	3	3	2	5	0	0	14	3	3
10/11	28.5°N	176.4°W	1200	99	06	16	02	0	1025.1	0	0.8	77.0	72.9	77.0	1	1	1	5	0	0	06	3	4
10/15	28.6°N	178.1°W	0600	99	08	12	02	2	1019.6	4	0.7	76.4	72.9	78.4	8	8	6	5	X	X	04	2	1
10/15	28.9°N	178.6°W	1200	99	09	08	02	2	1020.7	6	0.7	76.0	72.8	77.4	6	6	4	5	0	0	XX	X	X
10/15	29.3°N	179.2°W	1800	99	06	05	02	0	1021.3	4	0.2	75.5	68.8	76.3	1	1	8	X	0	0	06	3	2
10/16	29.8°N	179.9°E	0000	99	15	10	02	0	1019.0	8	1.7	81.3	74.5	76.9	1	1	8	6	0	0	12	2	0
10/16	30.3°N	179.7°E	0600	99	00	00	02	1	1019.3	4	0.7	77.9	74.8	76.8	7	7	5	4	0	0	15	4	0
10/16	31.2°N	179.7°E	1200	99	18	05	02	1	1020.0	3	0.0	76.1	72.2	74.9	1	1	1	4	0	0	15	5	0
10/17	32.7°N	179.9°E	0000	99	08	16	03	1	1021.0	0	1.0	74.2	71.9	74.5	6	4	8	4	0	8	36	3	2

Table 3.--Log of ship's weather observations, Charles H. Gilbert cruise 17, September 17 to November 7, 1954. Results in International Ship's Weather Code, January 1954 (cont'd)

Date, 1954	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
10/17	33.4°N	179.9°E	0600	99	10	16	03	1	1021.7	4	1.3	71.2	68.2	73.0	6	5	2	4	2	0	09	2	2
10/17	34.9°N	179.9°E	1800	99	17	12	03	1	1020.3	6	1.0	70.0	67.5	72.2	7	7	5	4	0	0	31	2	2
10/18	35.6°N	179.9°E	0000	99	16	15	02	2	1017.3	8	2.1	70.1	69.5	69.8	8	6	6	5	2	X	16	2	1
10/18	36.6°N	180.0°	0600	90	21	24	02	2	1010.8	8	1.8	71.1	68.9	68.0	9	9	X	0	X	X	21	2	3
10/18	36.4°N	180.0°	1200	95	20	26	80	2	1006.1	8	3.0	71.8	69.3	65.6	X	X	X	X	X	X	20	3	7
10/18	36.1°N	179.9°W	1800	95	20	35	80	2	1002.4	6	2.0	71.8	70.2	68.0	8	8	7	4	X	X	20	3	9
10/19	35.8°N	179.9°W	0000	96	23	17	16	2	1004.1	3	0.0	70.5	69.0	69.0	7	6	3	4	0	9	23	3	8
10/19	36.0°N	180.0°	0600	97	04	35	01	1	1011.5	3	5.2	62.6	60.9	68.7	6	6	4	4	0	0	05	4	9
10/19	36.2°N	179.8°W	1200	98	06	30	02	1	1018.6	3	1.2	62.7	56.0	66.6	6	X	X	X	X	X	06	3	7
10/19	36.4°N	179.6°W	1800	99	04	30	02	1	1022.4	3	2.0	60.5	59.2	65.2	8	6	2	4	6	1	06	3	7
10/20	37.0°N	179.6°W	0000	99	06	20	02	1	1026.4	0	0.4	59.8	53.5	63.0	4	3	4	4	8	0	06	3	6
10/20	37.5°N	179.8°W	0600	98	06	21	02	1	1028.8	3	1.2	60.0	52.2	63.8	4	4	4	4	8	8	06	3	6
10/20	38.3°N	180.0°	1200	98	07	10	02	1	1030.5	0	0.0	55.7	50.3	58.4	X	X	X	X	X	X	06	3	4
10/20	39.2°N	179.7°E	1800	99	07	06	01	2	1030.5	5	0.8	55.3	48.7	59.7	7	3	4	4	1	9	05	3	2
10/21	39.7°N	179.6°E	0000	99	17	20	02	1	1029.5	8	3.7	58.1	52.3	59.1	3	1	1	4	7	6	19	2	1
10/21	40.6°N	179.6°E	0600	99	20	27	02	1	1021.3	6	2.0	59.2	54.4	57.2	8	6	4	4	6	X	17	4	4
10/21	41.8°N	179.6°E	1200	90	20	42	51	6	1002.7	8	10.0	57.5	57.0	58.7	9	9	X	0	X	X	20	3	7
10/22	41.9°N	179.7°W	0000	99	04	37	02	1	1073.6	3	0.6	53.1	48.2	55.6	8	6	4	4	1	X	36	6	8
10/22	42.0°N	179.8°W	0600	98	29	49	15	1	1011.5	1	1.6	51.8	46.7	56.1	6	4	8	4	9	9	29	3	9
10/22	42.0°N	180.0°	1200	98	33	32	02	1	1014.9	1	1.1	57.0	47.2	55.9	1	1	1	4	0	0	33	4	9
10/22	42.1°N	179.9°E	1800	99	31	38	02	1	1016.6	3	1.3	50.2	47.7	55.9	2	1	1	4	0	0	32	4	8
10/23	42.5°N	179.8°E	0000	99	35	22	03	1	1015.6	7	2.0	50.0	45.0	53.0	8	8	3	4	X	X	01	4	8
10/23	43.3°N	179.8°E	0600	99	31	07	02	1	1014.6	6	0.6	48.0	46.8	52.1	8	7	4	4	3	X	31	4	4
10/23	44.1°N	179.8°E	1200	99	27	08	02	1	1011.5	8	2.1	47.2	46.5	49.1	X	X	X	X	X	X	36	5	4
10/23	44.8°N	179.8°E	1800	99	31	15	03	1	1008.8	6	0.8	46.3	42.9	48.5	2	2	4	4	0	8	36	5	2
10/24	45.0°N	178.7°E	0600	99	30	29	02	1	1013.9	1	3.0	44.8	40.0	49.0	2	2	2	4	0	0	30	4	4
10/24	45.0°N	177.7°E	1200	99	35	25	02	1	1019.3	3	2.0	44.0	41.9	48.1	X	X	X	X	X	X	34	4	6
10/24	44.9°N	176.4°E	1800	99	03	28	02	1	1023.4	3	2.4	45.6	41.9	47.2	8	4	4	4	6	X	04	4	5
10/25	45.0°N	174.8°E	0600	99	21	14	02	2	1020.0	8	1.7	48.4	45.1	48.9	8	8	4	4	X	X	22	4	2
10/25	45.0°N	173.5°E	1200	90	15	34	53	7	1008.5	8	6.8	48.0	46.0	49.7	9	9	X	0	X	X	17	3	5

Log of ship's weather observations, *Charles H. Gilbert* cruise 17, September 17 to November 7, 1954. Results in International Ship's Weather Code, January 1954 (cont'd)

Date, 1954	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
10/25	45.0°N	172.1°E	1800	99	29	27	02	2	988.5	8	3.7	49.0	45.1	48.9	3	3	2	4	0	0	29	3	5
10/26	44.5°N	171.7°E	0000	92	33	62	25	6	-	3	11.0	-	-	-	8	8	7	4	X	X	84	6	5
10/26	43.9°N	171.8°E	0600	96	34	38	25	6	1006.8	3	6.0	48.3	-	53.4	8	8	7	4	X	X	84	6	5
10/27	41.3°N	172.3°E	0600	98	31	25	15	2	1015.6	3	0.0	51.3	47.1	52.7	8	8	5	-	X	X	31	3	5
10/27	40.3°N	172.2°E	1200	98	27	25	50	5	1018.0	1	1.1	55.2	49.8	59.0	X	X	X	X	X	X	30	3	6
10/27	39.5°N	172.0°E	1800	99	30	27	02	2	1019.0	1	1.2	58.4	51.8	62.6	8	8	4	4	X	X	27	3	5
10/28	38.5°N	171.9°E	0000	99	30	28	01	2	1020.3	0	0.8	59.0	53.9	63.6	4	1	8	4	8	0	30	3	4
10/28	37.6°N	171.8°E	0600	99	34	21	02	2	1020.7	3	0.2	59.7	54.2	65.4	6	5	2	4	2	9	34	4	4
10/28	36.7°N	171.7°E	1200	99	31	17	02	2	1021.3	3	0.2	60.0	56.7	65.3	8	X	X	X	X	X	31	4	4
10/29	35.2°N	171.5°E	0000	96	13	13	60	2	1019.3	9	2.0	66.0	60.5	70.0	8	8	7	3	X	X	33	5	2
10/29	34.2°N	171.5°E	0600	98	10	17	02	2	1017.3	0	0.6	72.8	59.8	68.8	8	8	8	X	X	X	01	4	3
10/29	33.4°N	171.5°E	1200	93	17	27	60	2	1017.6	6	1.0	66.0	63.2	72.2	X	X	X	X	X	X	17	2	3
10/29	32.2°N	171.5°E	1800	94	19	23	50	2	1016.6	1	1.0	71.0	68.5	72.6	8	8	7	3	X	X	17	3	4
10/30	31.4°N	172.0°E	0600	99	17	18	01	2	1016.3	1	0.6	73.8	71.2	73.3	6	4	7	4	0	9	17	3	3
10/30	31.2°N	172.8°E	1200	99	13	04	02	2	1017.6	3	0.6	74.5	71.5	72.6	X	X	X	X	X	X	13	3	3
10/30	31.0°N	173.9°E	1800	97	20	14	60	2	1016.9	1	2.0	74.8	72.3	75.3	8	6	4	4	3	X	20	2	3
10/31	30.8°N	174.5°E	0000	99	17	20	02	2	1015.9	-	-	77.0	73.5	75.9	7	5	4	4	2	0	17	3	3
10/31	30.4°N	175.4°E	0600	99	19	14	01	1	1015.6	1	1.0	80.0	74.5	76.2	3	2	8	4	4	0	19	3	2
10/31	30.1°N	176.0°E	1200	99	16	14	01	1	1015.9	9	0.6	77.1	73.1	77.7	X	X	X	X	X	X	16	2	0
11/1	29.5°N	177.6°E	0000	99	19	15	03	0	1015.2	6	1.0	78.8	71.2	76.7	1	1	0	X	4	9	20	2	2
11/1	29.1°N	178.5°E	0600	99	22	11	02	0	1015.2	3	0.3	75.8	70.5	74.8	1	1	0	X	4	0	18	0	1
11/1	28.7°N	179.2°E	1200	99	22	12	02	0	1016.3	8	0.4	75.3	70.5	75.5	1	X	X	X	X	X	20	3	2
11/1	28.3°N	179.9°W	1800	99	26	10	02	0	1016.3	3	1.1	75.1	69.7	75.1	1	1	1	6	2	1	25	0	1
11/2	28.0°N	179.1°W	0000	99	25	11	02	0	1014.6	8	2.0	77.9	71.1	77.0	1	1	1	7	0	8	25	2	0
11/2	27.7°N	178.1°W	0600	99	27	10	02	0	1013.9	3	0.2	77.7	71.9	77.4	2	2	1	5	0	1	27	2	1
11/2	27.2°N	176.2°W	1700	99	29	05	02	1	1014.2	3	0.2	76.0	71.8	78.0	2	2	1	5	0	0	29	X	1
11/3	26.9°N	175.1°W	0000	99	26	07	02	1	1013.5	8	1.6	79.9	74.7	77.6	4	4	1	5	0	1	26	2	2
11/3	26.6°N	174.1°W	0600	99	29	10	02	1	1013.5	1	0.7	79.8	75.4	76.7	1	1	1	5	0	1	30	2	1
11/3	26.2°N	173.1°W	1200	99	25	04	02	0	1014.9	6	0.6	75.7	72.8	75.3	1	X	X	X	X	X	25	2	1
11/3	25.9°N	172.1°W	1800	98	34	12	16	2	1015.6	4	1.0	76.0	72.6	78.5	8	8	3	X	X	X	34	3	3

Table 3.--Log of ship's weather observations, Charles H. Gilbert cruise 17, September 17 to November 7, 1954. Results in International Ship's Weather Code, January 1954 (cont'd)

Date, 1954.	Latitude	Longitude	Time, GCT	Visibility	Wind		Wea-ther		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
11/4	25.6°N	171.5°W	0600	98	06	15	01	2	1013.9	3	0.2	78.0	72.3	78.3	7	2	1	4	9	6	06	3	3
11/4	25.0°N	170.5°W	1200	94	06	12	21	6	1015.9	9	0.7	74.7	73.2	79.0	6	6	7	X	0	0	XX	X	X
11/4	24.7°N	169.9°W	1700	96	17	06	58	5	1015.9	0	0.4	74.1	73.0	78.4	9	9	X	3	X	X	04	X	0
11/5	24.2°N	168.9°W	0000	99	20	05	02	0	1015.9	9	0.8	79.0	72.9	79.0	1	1	5	4	7	9	36	3	4
11/5	23.8°N	167.9°W	0600	99	21	05	02	0	1016.3	1	0.9	80.0	73.0	79.9	1	1	1	4	0	1	33	3	3
11/5	23.5°N	167.0°W	1200	99	10	02	02	0	1016.9	9	1.0	76.9	70.5	78.8	1	1	1	4	0	0	10	X	0
11/5	23.3°N	166.0°W	1800	99	09	10	02	0	1016.9	3	1.4	78.1	70.7	78.1	1	1	5	X	0	0	02	3	3
11/6	23.0°N	165.0°W	0000	99	11	05	03	1	1015.6	6	2.0	81.7	75.4	79.9	7	4	X	7	7	0	00	X	0
11/6	22.8°N	164.1°W	0600	99	06	06	02	0	1016.3	3	1.0	76.0	70.6	78.5	1	1	1	X	0	0	02	4	3
11/6	22.5°N	163.1°W	1200	99	10	09	02	0	1017.3	0	0.3	78.2	73.1	77.9	1	1	1	5	0	0	XX	X	X
11/6	22.3°N	162.2°W	1800	99	04	18	03	0	1016.9	3	1.2	83.2	78.6	78.9	3	1	2	5	7	1	04	3	2
11/7	22.0°N	161.2°W	0000	99	06	14	02	0	1015.2	8	2.0	79.5	72.0	80.0	1	1	1	4	0	0	02	4	3

NOTES ON TABLE 4, TABULATED OCEANOGRAPHIC DATA, HMS 27

Where more than one cast was made on a station, they are divided in the observed data by a horizontal line, and the cast number indicated by Roman numerals.

Weather is recorded in the ww (present weather) code given in the U. S. Weather Bureau circular M, eighth edition, Manual of Marine Meteorological Observations. Cloud cover is in tenths of the sky.

At stations 1 through 38 the wind velocity was measured with an anemometer approximately 15 meters above the sea surface. At the remainder of the stations, they were estimated according to the Beaufort scale and were converted to speed using range of the Beaufort force given in the Manual of Marine Meteorological Observations, circular M, table 3. The direction (given to the nearest 10°) is that from which the wind was blowing, measured through 360° from north.

The following abbreviations, when appended to values or lines in the tabulated data have the following meanings:

Q -- The value seems questionable, but was used in construction of the station curve.

P -- The value is poor, and while carried was not used in drawing the station curve.

NG -- The value is obviously in error, and was dropped from the tabulations.

PT -- Nansen bottle pretripped, and data was unuseable.

Table 4.--Oceanographic station data

STATION 1

M/V *Hugh M. Smith*: Cruise 27, 22°34'N., 159°38'W., January 6, 1955. Messenger time: 1943 GCT. Weather: 02, cloud coverage 3. Wind: 160°, 8 kt. Sea: 3-5 ft. Wire angle: 03°. BT slide: 1

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.33	35.19	23.71	5.27	0.21
53	23.94	35.26	23.88	5.02	0.37
105	22.22	35.32 Q	24.42 Q	4.97	0.35
158	20.13	35.26	24.94	4.88	0.34
215	18.17	34.97	25.23	4.82	0.39
320	12.21	34.25	25.99	4.59	1.11
430	08.55	34.14	26.53	3.89	1.84
533	06.56	34.13	26.81	2.44	2.69
644	05.56	34.23	27.02	1.59	2.82
859	04.56	34.40	27.27	1.21	2.74
1065	03.79	34.51	27.43	1.44	2.98
1065	03.74	34.51	27.44	-	-
1263	03.27	34.54	27.51	1.63	3.18

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	24.33	35.19	23.71	0.000	1.851
10	24.29	35.20	23.73	0.042	1.809
20	24.24	35.21	23.75	0.084	1.767
30	24.16	35.22	23.78	0.125	1.726
50	23.98	35.25	23.86	0.207	1.644
75	23.54	35.29	24.02	0.307	1.544
100	22.58	35.32	24.32	0.402	1.449
150	20.10	35.25	24.94	0.571	1.280
200	19.12	35.11	25.09	0.721	1.130
250	16.70	34.75	25.41	0.861	0.990
300	13.50	34.37	25.82	0.984	0.867
400	09.40	34.16	26.42	1.182	0.669
500	07.07	34.12	26.74	1.337	0.514
600	05.90	34.19	26.95	1.466	0.385
700	05.21	34.28	27.10	1.578	0.273
800	04.80	34.36	27.21	1.678	0.173
1000	03.99	34.48	27.40	1.851	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 2

M/V *Hugh M. Smith*: Cruise 27, 23°52'N., 162°29'W., January 7, 1955. Messenger time: first cast 2146 GCT, second cast 2253 GCT. Weather: 02, cloud coverage 1. Wind: 170°, 20 kt. Sea: 3-5 ft. Wire angle: first cast 15°, second cast not recorded. BT slide: 6

OBSERVED

	DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
	0	23.63	35.32	24.01	5.21	0.19
I	31	23.61	35.32	24.02	5.04	0.25
	67	23.61	35.34	24.03	5.18	0.26
	104	23.45	35.37	24.10	4.98	0.28
	162	20.40	35.25	24.86	4.84	0.28
II	229	18.30	34.97	25.19	4.75	0.37
	344	12.43	34.29	25.97	4.69	0.95
	464	08.50	34.05	26.47	4.20	1.60
	578	06.36	34.05	26.78	2.86	2.41
	692	05.28	34.29	27.10	1.78	2.84
	915	04.49	34.38	27.26	1.09	3.08
	1154	03.57	34.45	27.41	1.26	3.04
	1154	03.50	34.45	27.42	-	-
	1367	03.14	34.54	27.53	1.57	2.88

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	23.63	35.32	24.01	0.000	1.926
10	23.62	35.32	24.02	0.039	1.887
20	23.62	35.32	24.02	0.078	1.848
30	23.61	35.32	24.02	0.117	1.809
50	23.61	35.31	24.01	0.196	1.730
75	23.60	35.36	24.05	0.294	1.632
100	23.49	35.36	24.08	0.391	1.535
150	20.83	35.28	24.77	0.569	1.357
200	19.59	35.15	25.00	0.725	1.201
250	17.28	34.84	25.34	0.869	1.057
300	14.80	34.52	25.66	0.998	0.928
400	10.28	34.15	26.26	1.211	0.715
500	07.75	34.02	26.56	1.382	0.544
600	06.06	34.10	26.86	1.525	0.401
700	05.25	34.29	27.11	1.641	0.285
800	04.90	34.34	27.19	1.742	0.184
1000	04.12	34.41	27.33	1.926	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 4

M/V Hugh M. Smith: Cruise 27, 23°12'N., 165°03'W., January 8, 1955. Messenger time: 1738 GCT. Weather: 16, cloud coverage 3. Wind: 140°, 15 kt. Sea: 1-3 ft. Wire angle: 05°. BT slide: 10

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	23.42	35.26	24.03	4.56	0.20
22	23.26	35.34	24.14	5.16	0.21
54	23.04	35.35	24.21	5.19	0.18
107	21.63	35.35	24.60	5.08	0.20
127	20.74	35.21	24.74	5.04	0.23
219	17.27	34.85	25.35	4.93	0.39
PT	-	-	-	-	-
446	10.11	34.22	26.34	4.61	1.21
553	06.89	34.11	26.76	2.67	2.24
666	05.60	34.22	27.01	1.42	2.61
903	04.44	34.40	27.28	1.03	2.90
1183	03.64	34.49	27.44	1.44	2.95
1183	03.58	34.49	27.45	-	-
1424	03.14	34.54	27.53	1.65	2.73

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.42	35.26	24.03	0.000	1.873
10	23.33	35.33	24.11	0.039	1.834
20	23.27	35.34	24.13	0.077	1.796
30	23.19	35.35	24.16	0.115	1.758
50	23.07	35.36	24.21	0.190	1.683
75	22.79	35.38	24.30	0.282	1.591
100	22.20	35.38	24.47	0.372	1.501
150	19.82	35.13	24.93	0.537	1.336
200	17.88	34.92	25.26	0.684	1.189
250	16.28	34.72	25.49	0.818	1.055
300	14.72	34.54	25.70	0.942	0.931
400	11.58	34.31	26.15	1.160	0.713
500	08.14	34.11	26.58	1.336	0.537
600	06.28	34.15	26.87	1.477	0.396
700	05.33	34.28	27.09	1.594	0.279
800	04.80	34.36	27.21	1.695	0.178
1000	04.11	34.44	27.35	1.873	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 6

M/V Hugh M. Smith: Cruise 27, 22°29'N., 167°30'W., January 9, 1955. Messenger time: 1237 GCT. Weather: 64, cloud coverage 2. Wind: 120°, 18 kt. Sea: 1-3 ft. Wire angle: 07°. BT slide: 14

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	24.27	35.28	23.79	5.08	0.15
23	23.74	35.43	24.06	5.02	0.14
65	23.22	35.48	24.26	4.92	0.10
109	22.03	35.35	24.49	4.67	0.15
161	19.82	35.19	24.97	4.70	0.20
219	17.27	34.83	25.34	4.68	0.34
326	12.67	34.16	25.83	4.34	0.86
436	09.51	34.16	26.40	3.46	1.42
534	07.42	34.14	26.70	1.92	2.22
650	05.98	34.22	26.96	1.28	2.60
860	04.78	34.42	27.26	0.87	2.90
PT	-	-	-	-	-
PT	-	-	-	-	-

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.27	35.28	-	-	-
10	24.25	35.30	-	-	-
20	23.80	35.41	-	-	-
30	23.69	35.42	-	-	-
50	23.55	35.45	-	-	-
75	23.18	35.48	-	-	-
100	22.33	35.38	-	-	-
150	20.35	35.24	-	-	-
200	18.45	35.00	-	-	-
250	15.67	34.56	-	-	-
300	13.59	34.28	-	-	-
400	10.45	34.16	-	-	-
500	08.02	34.14	-	-	-
600	06.48	34.17	-	-	-
700	05.60	34.27	-	-	-
800	05.04	34.36	-	-	-

Table 4.--Oceanographic station data (cont'd)

STATION 7

M/V Hugh M. Smith: Cruise 27, 21°35'N., 170°18'W., January 10, 1955. Messenger time: 0640 GCT. Weather: 02, cloud coverage 2. Wind: 190°, 7 kt. Sea: 3-5 ft. Wire angle: 02°. BT slide: 18

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σt	O_2 (ml/l)	PO_4-P (μg at/l)
0	25.00	35.19	23.50	4.89	0.23
19	24.54	35.26	23.70	4.84	0.22
52	24.52	35.28	23.72	4.82	0.17
100	22.68	35.32	24.29	4.86	0.20
156	20.95 Q	35.19	24.67 Q	4.38	0.31
156	20.79 Q	35.19	24.71 Q	-	-
210	17.96	35.01	25.31	4.30	0.42
311	12.33	34.14	25.88	4.44	0.92
417	08.72	34.14	26.51	3.55	1.69
520	06.84	34.20	26.83	1.77	2.57
626	05.58	34.27	27.05	1.13	2.75
835	04.59	34.47	27.32	1.07	2.89
1035	04.26	34.52	27.40	1.34	2.90
1241	03.76	34.56	27.48	1.54	2.69

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σt	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	25.00	35.19	23.51	0.000	1.840
10	24.77	35.23	23.61	0.043	1.797
20	24.53	35.26	23.70	0.086	1.754
30	24.53	35.28	23.72	0.128	1.712
50	24.52	35.28	23.72	0.212	1.628
75	24.50	35.28	23.72	0.317	1.523
100	22.68	35.32	24.29	0.416	1.424
150	21.03	35.20	24.66	0.592	1.248
200	18.55	35.06	25.20	0.747	1.093
250	15.85	34.61	25.50	0.882	0.958
300	12.98	34.18	25.78	1.004	0.836
400	09.12	34.14	26.45	1.202	0.638
500	07.18	34.18	26.77	1.354	0.486
600	05.83	34.24	27.00	1.479	0.361
700	05.02	34.38	27.20	1.584	0.256
800	04.63	34.46	27.31	1.674	0.166
1000	04.32	34.51	27.38	1.840	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 8

M/V Hugh M. Smith: Cruise 27, 20°41'N., 172°18'W., January 11, 1955. Messenger time: .0034 GCT. Weather: 62, cloud coverage 5. Wind: 020°, 20 kt. Sea: 5-8 ft. Wire angle: 22°. BT slide: 22

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.60	35.32	23.72	4.86	0.18
20	24.58	35.35	23.75	4.79	0.19
66	24.48	35.37	23.80	4.80	0.16
110	24.34	35.37	23.84	4.81	0.16
163	20.09	35.19	24.90	4.72	0.28
219	17.28	34.85	25.35	4.64	0.45
329	11.32	34.23	26.13	4.15	1.14
443	08.26	34.14	26.58	2.97	2.03
550	06.46	34.18	26.87	1.69	2.57
662	05.35	34.33	27.13	1.10	2.74
875	04.66	34.45	27.30	1.24	2.83
1091	03.96	34.54	27.45	1.63	2.68
1091	03.90	34.54	27.45	-	-
1296	03.41	34.51	27.47	1.85	2.52

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.60	35.32	23.72	0.000	1.827
10	24.60	35.34	23.74	0.042	1.785
20	24.58	35.35	23.75	0.083	1.744
30	24.55	35.38	23.79	0.125	1.702
50	24.51	35.38	23.80	0.208	1.619
75	24.47	35.38	23.81	0.311	1.516
100	24.41	35.38	23.83	0.414	1.413
150	20.45	35.22	24.83	0.597	1.230
200	18.08	34.96	25.24	0.746	1.081
250	15.30	34.62	25.63	0.878	0.949
300	12.38	34.32	26.01	0.991	0.836
400	09.28	34.15	26.43	1.179	0.648
500	07.22	34.15	26.74	1.333	0.494
600	05.90	34.25	26.99	1.460	0.367
700	05.12	34.38	27.19	1.566	0.261
800	04.82	34.43	27.27	1.659	0.168
1000	04.25	34.52	27.40	1.827	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 9

M/V Hugh M. Smith: Cruise 27, 20°50'N., 177°23'W., January 12, 1955. Messenger time: 1850 GCT. Weather: 02, cloud coverage 3. Wind: 070°, 22 kt. Sea: 5-8 ft. Wire angle: 25°. BT slide: 32

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.89	35.25	23.58	4.80	0.17
19	24.92	35.25	23.55	4.80	0.17
62	24.92	35.26	23.58	4.78	0.16
104	23.41	35.30	24.06	4.90	0.15
157	20.87	35.26	24.76	4.60	0.25
209	18.36	34.96	25.17	4.51	0.38
314	13.27	34.40	25.89	4.46	0.83
424	10.18	NG	-	NG	NG
530	07.12	34.14	26.75	2.34	2.35
635	05.80	34.23	26.99	1.44	2.50
844	04.96	34.43	27.25	1.24	2.76
1054	04.19	34.51	27.40	1.67	2.75
1054	04.12	34.51	27.41	-	-
1259	03.54	34.58	27.52	1.58	2.61

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.89	35.25	23.58	0.000	1.951
10	24.91	35.25	23.58	0.043	1.908
20	24.92	35.25	23.58	0.087	1.864
30	24.92	35.25	23.58	0.130	1.821
50	24.92	35.26	23.58	0.217	1.734
75	24.93	35.28	23.59	0.325	1.626
100	24.61	35.25	23.67	0.433	1.518
150	21.02	35.27	24.71	0.622	1.329
200	18.98	35.05	25.08	0.778	1.173
250	16.38	34.74	25.48	0.917	1.034
300	14.05	34.47	25.79	1.039	0.912
400	10.90	34.21	26.20	1.250	0.701
500	07.94	34.14	26.63	1.421	0.530
600	06.08	34.20	26.93	1.557	0.394
700	05.49	34.30	27.08	1.671	0.280
800	05.12	34.39	27.20	1.773	0.178
1000	04.35	34.49	27.37	1.951	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 10

M/V Hugh M. Smith: Cruise 27, 21°52'N., 179°58'E., January 13, 1955. Messenger time: 1355 GCT. Weather: 02, cloud coverage 3. Wind: 090°, 20 kt. Sea: not recorded. Wire angle: 25°. BT slide: 37

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	24.91	35.32	23.62	4.92	0.16
20	24.93	35.32	23.62	4.80	0.15
61	24.93	35.34	23.64	4.76	0.14
104	24.66	35.41	23.77	4.81	0.15
156	21.42	35.26	24.60	4.68	0.22
210	18.10	34.92	25.20	4.37	0.46
315	12.55	34.34	25.99	4.66	0.89
424	08.77	34.14	26.50	3.67	1.57
529	07.24	34.11	26.71	2.78	2.15
633	05.92	34.14	26.91	1.88	2.46
841	04.52	34.36	27.24	1.16	2.76
1051	03.92	34.51	27.43	1.43	2.85
1051	03.86	34.51	27.43	-	-
1254	03.38	34.56	27.52	1.67	2.64

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.91	35.32	23.63	0.000	1.922
10	24.92	35.32	23.63	0.043	1.879
20	24.93	35.32	23.63	0.086	1.836
30	24.93	35.32	23.63	0.128	1.794
50	24.93	35.33	23.63	0.214	1.708
75	24.92	35.34	23.64	0.321	1.601
100	24.72	35.39	23.74	0.428	1.494
150	21.81	35.29	24.51	0.620	1.302
200	18.85	35.01	25.09	0.781	1.141
250	15.40	34.63	25.62	0.916	1.006
300	13.28	34.41	25.90	1.032	0.890
400	09.25	34.16	26.44	1.226	0.696
500	07.69	34.12	26.65	1.383	0.539
600	06.30	34.12	26.84	1.522	0.400
700	05.32	34.22	27.04	1.643	0.279
800	04.69	34.32	27.19	1.746	0.176
1000	04.02	34.48	27.39	1.922	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 11

M/V Hugh M. Smith: Cruise 27, 22°31'N., 177°29'E., January 14, 1955. Messenger time: 0707 GCT. Weather: 02, cloud coverage 9. Wind: 090°, 17 kt. Sea: 3-5 ft. Wire angle: 13°. BT slide: 41

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	24.70	35.37	23.73	4.83	0.17
41	24.70	35.37	23.73	4.85	0.16
82	24.43	35.46	23.88	4.81	0.12
122	22.86	35.08 P	24.06 P	4.91	0.16
164	20.86	35.25	24.73	4.64	0.25
209	18.93	35.34 P	25.32 P	4.74	0.29
312	14.60	34.54	25.72	4.87	0.61
420	11.04	34.27	26.22	4.44	1.14
521	08.43	34.13	26.54	3.58	1.83
628	06.48	34.11	26.81	2.46	2.31
836	04.52	34.31	27.20	1.05	2.88
1041	04.10	34.47	27.38	1.34	2.93
1041	04.02	34.47	27.39	-	-
1244	03.48	34.56	27.51	1.62	2.65

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.70	35.37	23.73	0.000	2.006
10	24.70	35.37	23.73	0.042	1.964
20	24.70	35.37	23.73	0.084	1.922
30	24.70	35.37	23.73	0.125	1.881
50	24.68	35.37	23.74	0.209	1.797
75	24.49	35.45	23.86	0.313	1.693
100	24.39	35.46	23.89	0.414	1.592
150	21.35	35.30	24.65	0.600	1.406
200	19.35	35.05	24.99	0.760	1.246
250	17.12	34.82	25.37	0.904	1.102
300	15.05	34.58	25.66	1.032	0.974
400	11.68	34.32	26.14	1.252	0.754
500	08.90	34.15	26.49	1.433	0.573
600	06.98	34.10	26.73	1.586	0.420
700	05.50	34.17	26.98	1.715	0.291
800	04.67	34.28	27.16	1.823	0.183
1000	04.18	34.44	27.34	2.006	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 12

M/V *Hugh M. Smith*: Cruise 27, 23°18'N., 174°46'E., January 15, 1955. Messenger time: 0051 GCT. Weather: 02, cloud coverage 1. Wind: 080°, 13 kt. Sea: 3-5 ft. Wire angle: 00°. BT slide: 45

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	23.91	35.50	24.07	4.92	0.10
22	23.75	35.48	24.10	4.89	0.07
65	23.68	35.50	24.13	4.85	0.07
107	21.74	35.25	24.50	5.06	0.11
161	18.34	34.90	25.13	5.01	0.23
218	16.40	34.69	25.44	4.88	0.40
325	13.98	34.49	25.81	4.90	0.65
436	10.70	34.23	26.25	4.57	1.10
542	08.08	34.11	26.59	3.40	1.87
650	06.41	34.09	26.79	2.76	2.16
870	04.57	34.33	27.21	1.09	2.80
1081	03.86	34.49	27.42	1.26	2.89
1081	03.79	34.49	27.42	-	-
1295	03.40	34.54	27.50	1.63	2.60

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	23.91	35.50	24.07	0.000	1.925
10	23.79	35.49	24.09	0.038	1.887
20	23.76	35.48	24.10	0.077	1.848
30	23.76	35.49	24.10	0.115	1.810
50	23.75	35.50	24.11	0.192	1.733
75	23.66	35.50	24.14	0.287	1.638
100	22.25	35.30	24.40	0.380	1.545
150	18.95	34.96	25.02	0.544	1.381
200	16.82	34.74	25.38	0.686	1.239
250	15.49	34.61	25.58	0.815	1.110
300	14.42	34.53	25.75	0.935	0.990
400	11.80	34.32	26.12	1.152	0.773
500	09.02	34.16	26.48	1.335	0.590
600	07.10	34.09	26.71	1.489	0.436
700	05.83	34.14	26.92	1.623	0.302
800	05.00	34.24	27.09	1.737	0.188
1000	04.02	34.44	27.36	1.925	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 14

M/V Hugh M. Smith: Cruise 27, 23°57'N., 172°36'E., January 15, 1955. Messenger time: 1720 GCT. Weather: 60, cloud coverage 8. Wind: 060°, 30 kt. Sea: 8-12 ft. Wire angle: 28°. BT slide: 49

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σt	O_2 (ml/l)	PO_4-P (µg at/l)
0	24.84	35.41	23.72	5.14	0.20
41	24.82	35.41	23.72	4.80	0.14
82	24.77	35.44	23.76	4.79	0.11
117	22.68	35.39	24.34	5.01	0.12
157	21.15	35.35	24.73	4.71	0.20
198	19.95	35.21	24.95	4.65	0.32
298	16.34	34.69	25.45	4.89	0.41
403	13.86	NG	NG	NG	NG
504	10.88	34.25	26.23	4.43	1.16
602	08.40	34.13	26.55	3.62	1.64
809	05.12	34.18	27.03	1.48	2.52
1003	04.28	34.38	27.29	1.23	2.70
1003	04.23	34.38	27.29	-	-
1205	03.66	34.52	27.46	1.47	2.72

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σt	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	24.84	35.41	23.72	0.000	2.156
10	24.83	35.41	23.72	0.042	2.114
20	24.83	35.41	23.72	0.084	2.072
30	24.82	35.41	23.73	0.126	2.030
50	24.81	35.42	23.74	0.210	1.946
75	24.78	35.44	23.76	0.314	1.842
100	24.41	35.44	23.87	0.417	1.739
150	21.40	35.36	24.68	0.603	1.553
200	19.90	35.20	24.96	0.763	1.393
250	17.50	34.83	25.28	0.909	1.247
300	16.29	34.68	25.45	1.044	1.112
400	13.98	34.45	25.79	1.292	0.864
500	11.01	34.26	26.22	1.504	0.652
600	08.44	34.13	26.55	1.681	0.475
700	06.46	34.09	26.80	1.829	0.327
800	05.20	34.18	27.02	1.953	0.203
1000	04.28	34.38	27.29	2.156	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 16

M/V Hugh M. Smith: Cruise 27, 25°00'N., 169°30'E., January 16, 1955. Messenger time: 1519 GCT. Weather: 02, cloud coverage 3. Wind: 080°, 21 kt. Sea: 3-5 ft. Wire angle: 22°. BT slide: 54

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	22.51	35.23	24.27	5.06	0.11
45	22.52	35.21	24.25	5.06	0.13
89	21.84	35.12	24.38	5.13	0.14
128	18.04	34.88	25.19	5.02	0.29
171	16.85	34.76	25.38	5.01	0.39
216	16.29	34.70	25.47	5.12	0.47
324	14.94	34.60	25.70	4.76	0.63
437	11.81	34.34	26.13	4.63	1.10
546	09.00	34.18	26.50	4.29	1.61
653	06.78	34.11	26.77	3.15	2.15
867	04.48	34.25	27.16	1.25	2.89
1078	03.47	34.40	27.38	0.87	3.12
1078	03.42	34.40	27.39	-	-
1284	03.03	34.52	27.52	1.22	3.03

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	22.51	35.23	24.27	0.000	1.944
10	22.51	35.23	24.27	0.037	1.907
20	22.51	35.22	24.26	0.073	1.871
30	22.51	35.22	24.26	0.110	1.834
50	22.50	35.20	24.25	0.184	1.760
75	22.49	35.20	24.25	0.277	1.667
100	19.89	35.03	24.83	0.363	1.581
150	17.39	34.82	25.30	0.510	1.434
200	16.46	34.72	25.45	0.643	1.301
250	15.95	34.68	25.53	0.772	1.172
300	15.34	34.62	25.62	0.897	1.047
400	12.85	34.42	25.99	1.126	0.818
500	10.13	34.22	26.34	1.322	0.622
600	07.79	34.13	26.64	1.487	0.457
700	06.08	34.12	26.87	1.626	0.318
800	05.00	34.19	27.06	1.746	0.198
1000	03.80	34.34	27.30	1.944	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 17

M/V Hugh M. Smith: Cruise 27, 26°30'N., 169°35'E., January 17, 1955. Messenger time: 0345 GCT. Weather: 02, cloud coverage 1. Wind: 100°, 16 kt. Sea: 3-5 ft. Wire angle: 05°. BT slide: 57

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	21.64	35.37	24.62	5.10	0.12
43	21.48	35.37	24.67	5.09	0.11
85	21.51	35.37	24.65	5.12	0.13
128	18.24	34.90	25.15	5.02	0.28
171	16.78	34.76	25.40	5.06	0.34
218	15.94	34.69	25.54	5.04	0.48
325	14.26	34.52	25.78	4.84	0.70
438	12.04	34.38	26.12	4.82	1.03
544	09.47	34.20	26.44	4.34	1.52
654	06.96	34.07	26.71	3.86	2.01
871	04.66	34.18	27.08	1.52	2.86
1079	03.62	34.38	27.35	0.85	3.19
1079	03.57	34.38	27.36	-	-
1287	03.04	34.42	27.44	0.94	3.11

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	21.64	35.37	24.62	0.000	1.921
10	21.62	35.37	24.62	0.033	1.888
20	21.59	35.37	24.63	0.067	1.854
30	21.51	35.37	24.65	0.100	1.821
50	21.47	35.37	24.67	0.166	1.755
75	21.48	35.37	24.66	0.249	1.672
100	20.65	35.26	24.81	0.330	1.591
150	17.30	34.81	25.32	0.477	1.444
200	16.21	34.71	25.50	0.609	1.312
250	15.45	34.64	25.61	0.735	1.186
300	14.71	34.56	25.71	0.855	1.066
400	12.82	34.44	26.01	1.079	0.842
500	10.63	34.29	26.31	1.276	0.645
600	08.05	34.12	26.60	1.445	0.476
700	06.23	34.09	26.83	1.589	0.332
800	05.20	34.14	26.99	1.713	0.208
1000	03.96	34.32	27.27	1.921	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 19

M/V Hugh M. Smith: Cruise 27, 27°56'N., 169°50'E., January 17, 1955. Messenger time: 1558 GCT. Weather: 02, clear. Wind: 150°, 8 kt. Sea: 3-5 ft. Wire angle: 14°. BT slide: 60

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	21.33	35.37	24.70	5.09	0.14
41	21.35	35.34	24.67	5.14	0.13
83	20.78	35.35	24.83	5.30	0.13
124	19.20	34.97	24.96	5.09	0.23
NG	-	-	-	-	-
213	16.05	34.69	25.52	5.07	0.49
317	14.56	34.54	25.73	4.88	0.65
426	12.18	34.34	26.07	4.76	0.94
530	09.60	34.22	26.43	4.46	1.45
638	07.33	34.09	26.68	3.47	1.97
638	07.27	34.09	26.69	-	-
850	04.90	34.16	27.04	1.78	2.68
1060	03.86	34.29	27.26	0.91	3.04
1060	03.81	34.29	27.26	-	-
1269	03.14	34.42	27.43	0.90	3.02

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	21.33	35.37	24.70	0.000	1.931
10	21.33	35.36	24.70	0.033	1.898
20	21.33	35.35	24.69	0.065	1.866
30	21.34	35.34	24.68	0.098	1.833
50	21.32	35.34	24.68	0.164	1.767
75	20.90	35.35	24.81	0.244	1.687
100	20.75	35.35	24.85	0.324	1.607
150	17.80	34.85	25.23	0.472	1.459
200	16.38	34.72	25.46	0.607	1.324
250	15.47	34.63	25.60	0.733	1.198
300	14.80	34.57	25.70	0.855	1.076
400	12.85	34.39	25.97	1.081	0.850
500	10.35	34.26	26.33	1.279	0.652
600	07.98	34.11	26.60	1.447	0.484
700	06.40	34.09	26.80	1.591	0.340
800	05.28	34.14	26.98	1.717	0.214
1000	04.08	34.25	27.20	1.931	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 20

M/V Hugh M. Smith: Cruise 27, 29°33'N., 169°57'E., January 18, 1955. Messenger time: 0610 GCT. Weather: 02, cloud coverage 5. Wind: 250°, 16 kt. Sea: 3-5 ft. Wire angle: 30°. BT slide: 63

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	21.70	35.17	24.45	5.08	0.11
34	21.58	35.16	24.47	5.05	0.13
69	19.77	NG	NG	NG	NG
103	19.56	34.88	24.80	4.97	0.20
137	19.17 Q	34.85	24.88	4.76	0.31
137	19.05 Q	34.85	24.91	-	-
176	17.01	34.69	25.29	4.79	0.44
262	15.79	34.60	25.51	4.91	0.48
354	14.34	34.51	25.75	4.79	0.69
442	12.91	34.36	25.93	4.83	0.90
533	10.66	34.22	26.25	4.63	1.23
717	06.16	34.02	26.78	3.44	2.22
903	04.33	34.14	27.09	1.49	2.97
903	04.27	34.14	27.09	-	-
1102	03.50	34.29	27.29	0.80	3.05

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	21.70	35.17	24.45	0.000	2.027
10	21.68	35.17	24.46	0.035	1.992
20	21.62	35.16	24.46	0.070	1.957
30	21.59	35.16	24.47	0.105	1.922
50	20.58	35.02	24.64	0.173	1.854
75	19.67	34.90	24.79	0.254	1.773
100	19.58	34.88	24.80	0.334	1.693
150	18.61	34.80	24.99	0.489	1.538
200	16.65	34.66	25.35	0.632	1.395
250	15.89	34.61	25.49	0.764	1.263
300	15.33	34.58	25.59	0.891	1.136
400	13.61	34.43	25.85	1.129	0.898
500	11.58	34.28	26.13	1.343	0.684
600	08.80	34.12	26.48	1.526	0.501
700	06.45	34.02	26.74	1.680	0.347
800	05.12	34.06	26.94	1.811	0.216
1000	03.80	34.23	27.22	2.027	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 22

M/V Hugh M. Smith: Cruise 27, 31°07'N., 170°35'E., January 18, 1955. Messenger time: 1828 GCT. Weather: 02, cloud coverage 5. Wind: 270°, 20 kt. Sea: 3-5 ft. Wire angle: 31°. BT slide: 66

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.86	34.85	24.75	5.19	0.14
38	19.86	34.83	24.74	5.24	0.14
77	19.40	34.78	24.77	5.19	0.15
110	18.18	34.76	25.07	5.06	0.26
150	16.74	34.70	25.36	4.94	0.38
189	16.28	34.72	25.49	4.96	0.45
286	15.14	34.60	25.65	4.72	0.63
386	13.15	34.45	25.96	4.87	0.84
386	13.34	34.45	25.92	-	-
482	11.30	34.33	26.22	4.63	1.16
580	08.62	34.14	26.52	4.52	1.56
771	05.04	34.02	26.92	2.90	2.49
967	03.96	34.22	27.19	1.20	2.96
967	03.90	34.22	27.20	-	-
1160	03.25	34.40	27.40	0.76	2.97

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	19.86	34.85	24.70	0.000	1.931
10	19.86	34.84	24.70	0.033	1.898
20	19.86	34.84	24.70	0.065	1.866
30	19.86	34.83	24.69	0.098	1.833
50	19.86	34.83	24.69	0.163	1.768
75	19.45	34.78	24.76	0.245	1.686
100	18.87	34.78	24.91	0.324	1.607
150	16.74	34.70	25.36	0.468	1.463
200	16.15	34.70	25.50	0.598	1.333
250	15.59	34.64	25.58	0.724	1.207
300	14.89	34.59	25.70	0.846	1.085
400	12.98	34.43	25.97	1.072	0.859
500	10.81	34.30	26.28	1.272	0.659
600	08.12	34.10	26.57	1.444	0.487
700	06.09	33.96	26.74	1.593	0.338
800	04.73	34.05	26.98	1.722	0.209
1000	03.79	34.25	27.23	1.931	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 24

M/V Hugh M. Smith: Cruise 27, 29°33'N., 179°20'E., February 2, 1955. Messenger time: 0425 GCT. Weather: 61, cloud coverage 8. Wind: 220°, 18 kt. Sea: 3-5 ft. Wire angle: 13°. BT slide: 91

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.02	34.92	24.97	5.67	0.18
41	19.04	34.88	24.94	5.37	0.15
82	19.06	34.85	24.91	5.30	0.16
123	18.58	34.78	24.98	5.22	0.21
164	17.78 Q	34.69 Q	25.11 Q	5.02 Q	0.43 Q
210	15.07	34.51	25.60	5.02	0.58
313	13.38	34.51	25.95	4.92	0.79
421	11.31	34.25	26.15	4.88	1.07
421	11.47	34.25	26.12	-	-
524	08.62	34.11	26.50	4.64	1.57
631	06.32	33.93	26.69	3.88	2.04
841	04.36	34.14	27.09	1.63	2.81
1045	03.57	34.33	27.32	0.72	3.16
1254	03.16	34.34	27.36	0.65	3.08

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	19.02	34.92	24.97	0.000	1.839
10	19.02	34.91	24.97	0.030	1.809
20	19.03	34.90	24.96	0.060	1.779
30	19.03	34.89	24.95	0.090	1.749
50	19.05	34.88	24.94	0.151	1.688
75	19.06	34.86	24.92	0.227	1.612
100	18.91	34.83	24.93	0.304	1.535
150	17.92	34.71	25.09	0.454	1.385
200	15.45	34.53	25.53	0.590	1.249
250	14.25	34.51	25.77	0.711	1.128
300	13.58	34.51	25.91	0.823	1.016
400	11.86	34.30	26.09	1.033	0.806
500	09.28	34.14	26.42	1.220	0.619
600	06.88	33.94	26.62	1.381	0.458
700	05.39	34.00	26.86	1.521	0.318
800	04.60	34.10	27.03	1.641	0.198
1000	03.67	34.31	27.29	1.839	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 26

M/V Hugh M. Smith: Cruise 27, 31°10'N., 179°52'E., February 2, 1955. Messenger time: 1835 GCT. Weather: 02, cloud coverage 6. Wind: 320°, 12 kt. Sea: 3-5 ft. Wire angle: 05°. BT slide: 94

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	18.80	34.90	25.01	5.29	0.14
43	18.80	34.90	25.01	5.34	0.14
PT	-	-	-	-	-
128	16.96	34.74	25.34	5.02	0.36
171	16.24	34.69	25.47	4.91	0.47
220	15.62	34.70	25.62	4.90	0.55
326	13.92	34.52	25.85	5.04	0.62
438	12.18	34.40	26.11	5.10	0.86
544	10.14	34.25	26.36	4.82	1.20
657	07.44	34.07	26.64	4.21	1.76
875	04.50	34.07	27.02	1.83	2.72
1084	03.70	34.16	27.17	1.27	2.90
1084	03.64	34.16	27.17	-	-
1300	03.12	34.34	27.37	0.64	3.00

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	18.80	34.90	25.01	0.000	1.911
10	18.80	34.90	25.01	0.030	1.881
20	18.80	34.90	25.01	0.059	1.852
30	18.80	34.90	25.01	0.089	1.822
50	18.80	34.90	25.01	0.148	1.763
75	18.70	34.89	25.03	0.222	1.689
100	17.48	34.78	25.25	0.294	1.617
150	16.60	34.71	25.40	0.429	1.482
200	15.88	34.70	25.56	0.557	1.354
250	15.17	34.64	25.68	0.679	1.232
300	14.35	34.55	25.78	0.796	1.115
400	12.79	34.45	26.03	1.016	0.895
500	11.03	34.31	26.25	1.215	0.696
600	08.80	34.16	26.51	1.391	0.520
700	06.62	34.00	26.70	1.546	0.365
800	05.15	34.01	26.90	1.681	0.230
1000	03.99	34.12	27.11	1.911	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 27

M/V *Hugh M. Smith*: Cruise 27, 32°32'N., 179°56'W., February 3, 1955. Messenger time: 0505 GCT. Weather: 15, cloud coverage 7. Wind: 290°, 19 kt. Sea: 5-8 ft. Wire angle: 40°. BT slide: 97

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	18.47	34.94	25.13	5.45	0.14
35	18.49	34.94	25.12	5.41	0.15
69	18.52	34.92	25.10	5.35	0.13
100	18.48	34.92	25.11	5.34	0.14
134	18.18	34.92	25.19	5.25	0.23
168	16.41	34.65	25.40	4.92	0.46
252	15.38	34.58	25.59	4.94	0.49
339	14.00	34.52	25.83	4.78	0.74
423	12.46	34.38	26.04	4.90	0.91
505	10.28	34.23	26.32	4.71	1.22
669	06.68	33.98	26.68	4.33	1.86
834	04.72	34.04	26.97	2.28	2.64
834	04.67	34.04	26.98	-	-
990	03.87	34.20	27.18	1.02	2.93

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	18.47	34.94	25.13	0.000	1.910
10	18.48	34.94	25.13	0.028	1.882
20	18.48	34.94	25.13	0.057	1.853
30	18.49	34.94	25.12	0.086	1.824
50	18.50	34.93	25.11	0.143	1.767
75	18.49	34.92	25.11	0.215	1.695
100	18.48	34.92	25.11	0.287	1.623
150	16.80	34.70	25.35	0.427	1.483
200	15.99	34.61	25.47	0.558	1.352
250	15.39	34.58	25.58	0.685	1.225
300	14.87	34.56	25.68	0.807	1.103
400	12.93	34.43	25.98	1.034	0.876
500	10.42	34.24	26.31	1.233	0.677
600	08.00	34.06	26.56	1.404	0.506
700	06.26	33.96	26.72	1.554	0.356
800	05.05	34.00	26.90	1.688	0.222
1000	03.87	34.20	27.19	1.910	0.000

STATION 29

M/V Hugh M. Smith: Cruise 27, 36°43'N., 179°30'E., February 4, 1955. Messenger time: 2115 GCT. Weather: 02, cloud coverage 4. Wind: 060°, 21 kt. Sea: 8-12 ft. Wire angle: 10°. BT slide: 105

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	15.03	34.56	25.56	5.73	0.31
48	15.00	34.54	25.64	5.72	0.31
96	14.13	34.49	25.78	5.23	0.54
138	13.50	34.42	25.86	5.26	0.57
185	12.60	34.42	26.04	5.20	0.74
233	12.10	34.36	26.09	4.82	0.90
350	10.09	34.22	26.35	4.36	1.13
472	07.95	34.07	26.57	4.67	1.46
589	05.68	33.93	26.77	3.85	1.98
705	04.66	34.02	26.96	1.86	2.37
931	03.84	34.22	27.20	1.30	2.71
1158	03.22	34.34	27.36	0.76	2.93
1158	03.17	34.34	27.36	-	-
1373	02.81	34.42	27.46	0.72	2.85

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	15.03	34.56	25.65	0.000	1.561
10	15.02	34.56	25.65	0.024	1.537
20	15.02	34.55	25.64	0.047	1.514
30	15.01	34.55	25.64	0.071	1.490
50	15.00	34.54	25.64	0.118	1.443
75	14.92	34.53	25.65	0.178	1.383
100	14.08	34.49	25.80	0.235	1.326
150	13.33	34.42	25.90	0.345	1.216
200	12.41	34.40	26.06	0.449	1.112
250	11.92	34.35	26.12	0.548	1.013
300	11.12	34.29	26.22	0.644	0.917
400	09.16	34.16	26.46	0.821	0.740
500	07.42	34.02	26.61	0.980	0.581
600	05.53	33.94	26.80	1.122	0.439
700	04.72	34.02	26.95	1.248	0.313
800	04.32	34.11	27.07	1.361	0.200
1000	03.65	34.26	27.25	1.561	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 30

M/V Hugh M. Smith: Cruise 27, 37°13'N., 177°36'W., February 5, 1955. Messenger time: 1441 GCT. Weather: 02, cloud coverage 5. Wind: 050°, 15 kt. Sea: 8-12 ft. Wire angle: 00°. BT slide: 108

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	14.87	34.58	25.70	5.71	0.27
42	14.87	34.60	25.71	5.65	0.26
84	14.55	34.52	25.72	5.65	0.31
126	14.28	34.51	25.77	5.67	0.31
168	14.02	34.51	25.82	5.75	0.34
215	13.74	34.47	25.85	5.82	0.40
320	12.68	34.42	26.03	5.14	0.67
429	11.00	34.31	26.26	5.17	0.88
534	09.46	34.22	26.45	5.22	1.10
642	07.54	34.09	26.65	4.40	1.51
857	04.84	34.00	26.92	2.40	2.35
1064	03.82	NG	NG	NG	NG
1275	03.26	NG	NG	NG	NG

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	14.87	34.58	25.70	0.000	1.753
10	14.87	34.58	25.70	0.023	1.730
20	14.87	34.59	25.70	0.046	1.707
30	14.87	34.60	25.71	0.069	1.684
50	14.87	34.60	25.71	0.115	1.638
75	14.70	34.54	25.70	0.173	1.580
100	14.41	34.52	25.75	0.231	1.522
150	14.15	34.50	25.79	0.344	1.409
200	13.78	34.48	25.85	0.456	1.297
250	13.61	34.46	25.87	0.566	1.187
300	12.99	34.43	25.97	0.675	1.078
400	11.47	34.34	26.20	0.877	0.876
500	10.00	34.25	26.39	1.060	0.693
600	08.29	34.15	26.58	1.226	0.527
700	06.61	34.01	26.71	1.377	0.376
800	05.36	33.97	26.84	1.514	0.239
1000	04.12	34.10	27.08	1.753	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 31

M/V Hugh M. Smith: Cruise 27, 37°00'N., 175°30'W., February 6, 1955. Messenger time: 0513 GCT. Weather: 02, cloud coverage 4. Wind: 120°, 16 kt. Sea: 5-8 ft. Wire angle: 35°. BT slide: 111

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	14.88	34.58	25.69	5.66	0.36
31	14.90	34.60	25.71	5.66	0.30
63	14.92	34.58	25.69	5.65	0.35
95	14.90	34.58	25.69	5.66	0.35
126	14.85	34.60	25.72	5.63	0.33
162	14.88	34.58	25.69	5.65	0.42
243	13.60	34.47	25.88	5.12	0.58
327	12.43	34.40	26.06	5.22	0.77
407	11.14	34.33	26.25	5.32	0.90
495	09.66	34.18	26.39	5.25	1.11
661	06.44	34.00	26.73	4.02	1.88
828	04.58	34.09	27.02	2.04	2.56
1006	03.90	34.23	27.21	1.14	2.81

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	14.88	34.58	25.69	0.000	1.709
10	14.88	34.59	25.70	0.023	1.686
20	14.89	34.59	25.70	0.046	1.663
30	14.90	34.60	25.70	0.069	1.640
50	14.91	34.59	25.69	0.115	1.594
75	14.91	34.58	25.69	0.174	1.535
100	14.90	34.58	25.69	0.232	1.477
150	14.87	34.59	25.70	0.349	1.360
200	14.11	34.51	25.80	0.464	1.245
250	13.41	34.46	25.91	0.575	1.134
300	12.73	34.42	26.02	0.681	1.028
400	11.28	34.34	26.23	0.879	0.830
500	09.60	34.18	26.40	1.060	0.649
600	07.60	34.06	26.62	1.224	0.485
700	05.87	33.98	26.79	1.368	0.341
800	04.80	34.05	26.97	1.495	0.214
1000	03.90	34.22	27.20	1.709	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 33

M/V Hugh M. Smith: Cruise 27, 36°49'N., 173°18'W., February 6, 1955. Messenger time: 2035 GCT. Weather: 02, cloud coverage 2. Wind: 080°, 20 kt. Sea: 3-5 ft. Wire angle: 20°. BT slide: 114

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	11.91	34.33	26.11	6.09 *	0.54
56	11.90	34.31	26.09	6.07	0.54
112	11.86	34.33	26.11	6.03	0.55
168	11.80	34.31	26.11	5.88	0.58
224	10.37	34.27	26.34	5.07	0.97
279	09.48	34.20	26.43	5.30	1.10
335	08.50	34.09	26.50	5.23	1.30
452	06.68	34.02	26.71	4.21	1.68
565	05.40	33.98	26.84	3.23	2.11
675	04.47	34.09	27.04	2.04	2.45
894	03.68	34.25	27.24	0.96	2.72
1112	03.08	34.36	27.39	0.59	2.88
1112	03.02	34.36	27.39	-	-
1319	02.74	34.45	27.49	0.55	2.91

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	11.91	34.33	26.11	0.000	1.377
10	11.91	34.33	26.11	0.019	1.358
20	11.91	34.32	26.10	0.038	1.339
30	11.90	34.32	26.10	0.058	1.319
50	11.90	34.31	26.09	0.096	1.281
75	11.88	34.32	26.10	0.145	1.232
100	11.87	34.33	26.11	0.193	1.184
150	11.81	34.32	26.12	0.290	1.087
200	10.78	34.28	26.27	0.384	0.993
250	09.94	34.24	26.39	0.471	0.906
300	09.07	34.14	26.45	0.555	0.822
400	07.40	34.04	26.63	0.711	0.666
500	06.08	33.99	26.77	0.852	0.525
600	05.07	34.00	26.90	0.982	0.395
700	04.34	34.12	27.07	1.096	0.281
800	03.94	34.20	27.18	1.198	0.179
1000	03.35	34.32	27.33	1.377	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 34

M/V Hugh M. Smith: Cruise 27, 35°17'N., 173°27'W., February 7, 1955. Messenger time: 0738 GCT. Weather: 02, cloud coverage 7. Wind: 140°, 19 kt. Sea: 5-8 ft. Wire angle: 22°. BT slide: 117

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	14.21	34.47	25.75	5.89	0.31
54	14.22	34.49	25.77	5.86	0.32
108	13.63	34.40	25.82	5.69	0.45
161	13.10	34.40	25.93	5.39	0.60
215	12.34	34.38	26.06	5.32	0.72
268	11.65	34.33	26.15	5.22	0.88
324	10.78	34.29	26.28	5.28	0.94
437	09.85 Q	NG	NG	NG	NG
546	07.50	34.04	26.61	4.69	1.55
654	05.68	33.98	26.81	3.50	2.06
865	04.29	34.18	27.13	1.64	2.63
1080	03.46	34.33	27.33	0.81	2.85
1080	03.40	34.33	27.33	-	-
1283	03.04	34.40	27.43	0.37	2.96

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	14.21	34.47	25.75	0.000	1.590
10	14.21	34.47	25.75	0.023	1.567
20	14.22	34.48	25.76	0.045	1.545
30	14.22	34.49	25.77	0.068	1.522
50	14.22	34.49	25.77	0.113	1.477
75	14.19	34.49	25.77	0.169	1.421
100	13.77	34.41	25.80	0.225	1.365
150	13.20	34.40	25.91	0.334	1.256
200	12.53	34.38	26.02	0.439	1.151
250	11.90	34.35	26.12	0.539	1.051
300	11.13	34.30	26.23	0.635	0.955
400	10.14	34.24	26.36	0.816	0.774
500	08.59	34.12	26.51	0.985	0.605
600	06.45	33.98	26.71	1.137	0.453
700	05.28	34.01	26.88	1.272	0.318
800	04.60	34.12	27.04	1.390	0.200
1000	03.72	34.28	27.26	1.590	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 36

M/V Hugh M. Smith: Cruise 27, 34°06'N., 173°12'W., February 7, 1955. Messenger time: 1829 GCT. Weather: 02, cloud coverage 8. Wind: 180°, 19 kt. Sea: 3-5 ft. Wire angle: 10°. BT slide: 120

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	14.65	34.47	25.66	5.71	0.30
57	14.68	34.47	25.65	5.71	0.30
PT	-	-	-	-	-
171	14.64	34.47	25.66	5.39	0.47
228	13.50	34.36	25.81	5.20	0.69
285	12.24	34.42	26.11	5.16	0.84
342	11.04	34.27	26.22	5.09	0.99
462	08.54	34.09	26.50	4.97	1.38
576	06.24	34.02	26.77	3.71	1.97
691	04.98	34.04	26.94	2.56	2.33
914	03.65	34.25	27.25	0.90	2.80
1138	03.18	34.40	27.41	0.69	2.90
1349	02.95	34.42	27.45	0.61	2.91

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	14.65	34.47	25.66	0.000	1.604
10	14.66	34.47	25.66	0.023	1.581
20	14.66	34.47	25.66	0.047	1.557
30	14.67	34.47	25.65	0.070	1.534
50	14.68	34.47	25.65	0.118	1.486
75	14.68	34.47	25.65	0.177	1.427
100	14.68	34.47	25.65	0.236	1.368
150	14.66	34.47	25.66	0.355	1.249
200	13.62	34.36	25.79	0.471	1.133
250	13.22	34.39	25.90	0.582	1.022
300	11.95	34.38	26.14	0.686	0.918
400	09.84	34.17	26.35	0.872	0.732
500	07.67	34.05	26.60	1.037	0.567
600	05.93	34.02	26.81	1.179	0.425
700	04.89	34.04	26.95	1.305	0.299
800	04.16	34.14	27.11	1.416	0.188
1000	03.45	34.31	27.31	1.604	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 38

M/V Hugh M. Smith: Cruise 27, 32°27'N., 173°02'W., February 8, 1955. Messenger time: 0917 GCT. Weather: 01, cloud coverage 8. Wind: 190°, 16 kt. Sea: 5-8 ft. Wire angle: 05°. BT slide: 123

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	16.30	34.65	25.43	5.62	0.27
54	16.30	34.63	25.41	5.55	0.25
106	16.28	34.61	25.40	5.51	0.27
160	15.65	34.58	25.52	5.30	0.40
217	14.68	34.49	25.67	5.51	0.41
273	14.06	34.47	25.78	5.12	0.65
325	13.25	34.43	25.92	5.11	0.74
438	11.08	34.29	26.23	5.03	1.04
544	09.10	34.11	26.43	4.75	1.39
657	07.21	33.98	26.61	4.38	1.75
657	07.15	33.98	26.62	-	-
875	04.16	34.14	27.11	1.48	2.81
1086	03.53	34.29	27.29	0.71	3.07
1086	03.46	34.29	27.30	-	-
1302	03.05	34.45	27.46	0.47	3.09

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	16.30	34.65	25.43	0.000	1.814
10	16.30	34.65	25.43	0.026	1.788
20	16.30	34.64	25.42	0.051	1.763
30	16.30	34.64	25.42	0.077	1.737
50	16.30	34.63	25.41	0.129	1.685
75	16.29	34.62	25.41	0.194	1.620
100	16.28	34.61	25.40	0.259	1.555
150	15.81	34.59	25.49	0.388	1.426
200	14.95	34.51	25.62	0.512	1.302
250	14.30	34.48	25.74	0.631	1.183
300	13.72	34.46	25.85	0.745	1.069
400	11.79	34.33	26.13	0.957	0.857
500	09.87	34.18	26.35	1.145	0.669
600	08.12	34.05	26.53	1.315	0.499
700	06.45	33.97	26.70	1.468	0.346
800	04.95	34.04	26.94	1.601	0.213
1000	03.72	34.24	27.23	1.814	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 39

M/V Hugh M. Smith: Cruise 27, 30°59'N., 172°57'W., February 8, 1955. Messenger time: 2058 GCT. Weather: 02, cloud coverage 8. Wind: 140°, 1-3 kt. Sea: 1-3 ft. Wire angle: 00°. BT slide: 126

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	18.45	35.07	25.23	5.33	0.17
21	18.45	35.05	25.22	5.33	0.17
42	18.46	35.03	25.20	5.32	0.16
84	18.36	35.01	25.21	5.33	0.17
126	16.30	34.63	25.41	5.22	0.37
215	14.46	34.51	25.73	4.76	0.69
320	12.16	34.34	26.07	5.11	0.82
429	10.44	34.22	26.29	5.03	1.13
530	08.28	34.05	26.51	4.74	1.53
644	06.16	33.98	26.75	3.46	2.14
857	04.28	34.13	27.09	1.41	2.89
1063	03.50	34.25	27.26	0.52	3.18
1063	03.43	34.25	27.27	-	-
1274	03.04	34.40	27.42	0.43	3.23

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	18.45	35.07	25.23	0.000	1.755
10	18.45	35.06	25.22	0.028	1.727
20	18.45	35.05	25.22	0.055	1.700
30	18.45	35.04	25.21	0.083	1.672
50	18.46	35.03	25.20	0.139	1.616
75	18.42	35.02	25.20	0.208	1.547
100	17.40	34.75	25.25	0.278	1.477
150	15.47	34.58	25.56	0.409	1.346
200	14.81	34.53	25.67	0.531	1.224
250	13.54	34.44	25.87	0.645	1.110
300	12.50	34.36	26.02	0.753	1.002
400	10.97	34.26	26.22	0.951	0.804
500	08.95	34.10	26.44	1.130	0.625
600	06.80	33.99	26.67	1.288	0.467
700	05.52	34.00	26.84	1.426	0.329
800	04.62	34.08	27.01	1.547	0.208
1000	03.69	34.21	27.21	1.755	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 41

M/V Hugh M. Smith: Cruise 27, 29°29'N., 172°41'W., February 9, 1955. Messenger time: 0923 GCT. Weather: 02, cloud coverage 2. Wind: 080°, 7-10 kt. Sea: 1-3 ft. Wire angle: 10°. BT slide: 129

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	17.70	34.88	25.27	5.57	0.22
53	16.82	34.60	25.27	5.60	0.21
106	16.39	34.60	25.37	5.50	0.29
159	15.41	34.58	25.58	5.12	0.48
217	14.36	34.47	25.72	5.00	0.64
269	13.44	34.42	25.87	5.17	0.72
323	12.46	34.34	26.01	5.15	0.78
434	10.29	34.20	26.30	4.81	1.17
540	08.50	34.07	26.49	4.40	1.57
650	06.18	34.04	26.80	3.40	2.19
868	04.16	34.16	27.12	1.18	2.98
1078	03.53	34.33	27.32	0.59	3.22
1078	03.48	34.33	27.33	-	-
1292	03.04	34.47	27.48	0.86	3.13

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	17.70	34.88	25.27	0.000	1.748
10	17.68	34.87	25.27	0.027	1.721
20	17.60	34.83	25.26	0.054	1.694
30	17.42	34.75	25.24	0.082	1.666
50	16.87	34.60	25.26	0.137	1.611
75	16.79	34.60	25.28	0.205	1.543
100	16.52	34.60	25.34	0.272	1.476
150	15.62	34.59	25.54	0.402	1.346
200	14.66	34.50	25.68	0.524	1.224
250	13.79	34.44	25.82	0.640	1.108
300	12.94	34.38	25.94	0.750	0.998
400	10.92	34.24	26.22	0.952	0.796
500	09.19	34.11	26.41	1.133	0.615
600	07.21	34.05	26.66	1.293	0.455
700	05.45	34.05	26.89	1.429	0.319
800	04.52	34.11	27.05	1.547	0.201
1000	03.76	34.27	27.25	1.748	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 42

M/V Hugh M. Smith: Cruise 27, 28°00'N., 172°34'W., February 9, 1955. Messenger time: 2029 GCT. Weather: 01, cloud coverage 8. Wind: 080°, 11-16 kt. Sea: 3-5 ft. Wire angle: 09°. BT slide: 132

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	20.42	35.34	24.93	5.18	0.14
47	20.44	35.35	24.93	5.10	0.12
94	20.04	35.25	24.96	5.18	0.15
136	17.72	34.83	25.23	5.10	0.27
184	16.28	34.70	25.47	4.91	0.44
231	14.98	34.54	25.64	4.91	0.58
346	12.29	34.36	26.06	4.92	0.94
466	10.35	34.23	26.31	4.84	1.23
581	07.58	34.04	26.61	3.90	1.91
695	05.71	34.00	26.82	2.75	2.45
918	03.94	34.23	27.20	0.76	3.16
1141	03.34	34.36	27.36	0.70	3.18
1141	03.28	34.36	27.37	-	-
1352	02.86	34.47	27.49	1.01	3.16

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	20.42	35.34	24.93	0.000	1.828
10	20.42	35.34	24.93	0.030	1.798
20	20.43	35.34	24.93	0.061	1.767
30	20.43	35.35	24.93	0.091	1.737
50	20.44	35.35	24.93	0.152	1.676
75	20.42	35.34	24.93	0.229	1.599
100	19.85	35.21	24.98	0.305	1.523
150	17.28	34.78	25.30	0.448	1.380
200	15.93	34.66	25.52	0.580	1.248
250	14.55	34.50	25.70	0.703	1.125
300	13.29	34.42	25.90	0.816	1.012
400	11.47	34.31	26.17	1.023	0.805
500	09.45	34.17	26.42	1.206	0.622
600	07.24	34.03	26.64	1.367	0.461
700	05.65	34.01	26.84	1.507	0.321
800	04.65	34.11	27.03	1.628	0.200
1000	03.65	34.29	27.28	1.828	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 44

M/V Hugh M. Smith: Cruise 27, 26°30'N., 171°56'W., February 10, 1955. Messenger time: 1010 GCT. Weather: 02, cloud coverage 3. Wind: 090°, 17-21 kt. Sea: 5-8 ft. Wire angle: 20°. BT slide: 135

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	21.75	35.46	24.65	5.01	0.12
79	21.76	35.48	24.67	5.04	0.12
159	21.76	35.44	24.63	4.96	0.12
187	19.56	35.08	24.96	4.80	0.25
223	17.30	34.85	25.34	4.83	0.36
264	15.83	34.67	25.55	4.90	0.47
303	14.62	34.54	25.72	4.88	0.62
408	12.40	34.36	26.04	4.79	0.95
507	10.16	34.20	26.32	4.43	1.39
612	07.41	34.07	26.65	3.37	2.06
818	05.06	34.14	27.01	1.66	2.86
1016	03.97	34.31	27.26	0.96	3.15
1222	03.44	34.38	27.37	0.96	3.13

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	21.75	35.46	24.66	0.000	1.985
10	21.75	35.46	24.66	0.033	1.952
20	21.75	35.46	24.66	0.066	1.919
30	21.75	35.46	24.66	0.099	1.886
50	21.76	35.47	24.66	0.165	1.820
75	21.76	35.48	24.67	0.248	1.737
100	21.76	35.46	24.65	0.331	1.654
150	21.76	35.44	24.64	0.498	1.487
200	18.58	34.98	25.13	0.655	1.330
250	16.24	34.70	25.48	0.793	1.192
300	14.75	34.55	25.70	0.917	1.068
400	12.56	34.38	26.02	1.141	0.844
500	10.32	34.21	26.30	1.338	0.647
600	07.67	34.08	26.62	1.506	0.479
700	06.22	34.06	26.80	1.650	0.335
800	05.21	34.13	26.98	1.775	0.210
1000	04.03	34.30	27.25	1.985	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 45

M/V Hugh M. Smith: Cruise 27, 28°00'N., 168°42'W., February 12, 1955. Messenger time: 1110 GCT. Weather: 01, cloud coverage 3. Wind: 050°, 17-21 kt. Sea: 5-8 ft. Wire angle: 20°. BT slide: 142

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.92	35.26	25.00	5.13	0.23
65	19.94	35.28	25.01	5.21	0.16
129	17.60	34.87	25.29	4.95	0.32
174	15.74	34.63	25.54	4.91	0.48
218	14.92	34.56	25.67	4.84	0.56
263	13.96	34.49	25.82	4.84	0.68
329	12.60	34.40	26.03	4.88	0.83
444	09.89	34.18	26.35	4.67	1.28
553	07.40	34.07	26.65	3.63	1.97
662	05.92	34.04	26.83	2.43	2.56
877	04.10	34.20	27.16	0.75	3.21
1092	03.50	34.33	27.32	0.47	3.39
1298	03.02	34.45	27.46	0.71	3.13

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	19.92	35.26	25.00	0.000	1.768
10	19.92	35.26	25.00	0.030	1.738
20	19.92	35.27	25.01	0.059	1.709
30	19.92	35.27	25.01	0.089	1.679
50	19.93	35.28	25.01	0.148	1.620
75	19.94	35.28	25.01	0.223	1.545
100	19.87	35.28	25.03	0.297	1.471
150	16.62	34.74	25.42	0.437	1.331
200	15.25	34.59	25.62	0.563	1.205
250	14.24	34.51	25.78	0.682	1.086
300	13.20	34.44	25.94	0.793	0.975
400	10.78	34.25	26.25	0.994	0.774
500	08.60	34.12	26.51	1.168	0.600
600	06.68	34.05	26.74	1.319	0.449
700	05.47	34.05	26.89	1.452	0.316
800	04.55	34.13	27.06	1.569	0.199
1000	03.72	34.28	27.26	1.768	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 46

M/V *Hugh M. Smith*: Cruise 27, 29°30'N., 166°41'W., February 13, 1955. Messenger time: 0617 GCT. Weather: 02, cloud coverage 2. Wind: 060°, 17-21 kt. Sea: 5-8 ft. Wire angle: 26°. BT slide: 147

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.53	35.30	25.13	5.27	0.15
74	19.48	35.30	25.14	5.24	0.16
147	19.40	35.26	25.13	5.23	0.16
175	19.40	35.28	25.15	5.22	0.12
207	17.98	34.90	25.22	5.33	0.14
244	16.29	34.72	25.49	4.88	0.42
280	14.42	34.52	25.74	4.86	0.63
379	12.76	34.38	25.98	5.20	0.78
472	10.86	34.27	26.25	5.19	1.05
570	08.72	34.11	26.48	4.67	1.51
763	05.44	34.09	26.92	2.28	2.61
954	04.13	34.25	27.20	0.73	3.15
954	04.05	34.25	27.21	-	-
1154	03.53	34.38	27.36	0.43	3.21

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	19.53	35.30	25.13	0.000	1.898
10	19.53	35.30	25.13	0.028	1.870
20	19.53	35.30	25.13	0.057	1.841
30	19.52	35.30	25.13	0.085	1.813
50	19.50	35.30	25.14	0.142	1.756
75	19.48	35.30	25.15	0.214	1.684
100	19.46	35.26	25.12	0.285	1.613
150	19.40	35.25	25.13	0.430	1.468
200	18.46	34.99	25.17	0.574	1.324
250	16.01	34.68	25.52	0.710	1.188
300	14.02	34.49	25.81	0.831	1.067
400	12.39	34.37	26.04	1.048	0.850
500	10.35	34.22	26.30	1.244	0.654
600	08.08	34.09	26.57	1.414	0.484
700	06.30	34.05	26.79	1.561	0.337
800	05.06	34.12	26.99	1.688	0.210
1000	03.95	34.28	27.24	1.898	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 48

M/V *Hugh M. Smith*: Cruise 27, 30°57'N., 166°49'W., February 13, 1955. Messenger time: 1933 GCT. Weather: 02, cloud coverage 4. Wind: 090°, 7-10 kt. Sea: 3-5 ft. Wire angle: 05°. BT slide: 150

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	19.40	35.32	25.18	5.24	0.20
53	18.92	35.21	25.22	5.33	0.18
105	16.95	34.85	25.43	5.49	0.21
160	16.20	34.67	25.47	5.30	0.31
218	14.38	34.61	25.82	5.00	0.62
271	13.32	34.45	25.92	5.15	0.73
324	12.53	34.40	26.04	5.16	0.76
434	10.38	34.25	26.32	5.26	1.05
434	10.44	34.25	26.31	-	-
541	08.69	34.11	26.49	4.39	1.53
652	06.58	34.04	26.74	3.42	2.08
868	04.52	34.13	27.06	1.28	2.89
1079	03.66	34.34	27.32	0.41	3.21
1079	03.61	34.34	27.32	-	-
1295	03.19	34.47	27.47	0.59	3.16

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	19.40	35.32	25.18	0.000	1.769
10	19.32	35.30	25.19	0.028	1.741
20	19.22	35.28	25.20	0.056	1.713
30	19.13	35.26	25.21	0.084	1.685
50	18.96	35.22	25.22	0.139	1.630
75	18.15	35.08	25.31	0.208	1.561
100	17.07	34.87	25.42	0.274	1.495
150	16.54	34.69	25.40	0.405	1.364
200	14.78	34.63	25.75	0.528	1.241
250	13.73	34.51	25.88	0.641	1.128
300	12.86	34.42	25.99	0.748	1.021
400	10.99	34.29	26.24	0.947	0.822
500	09.38	34.15	26.41	1.127	0.642
600	07.54	34.06	26.62	1.289	0.480
700	06.00	34.05	26.82	1.431	0.338
800	04.98	34.08	26.97	1.556	0.213
1000	03.97	34.25	27.22	1.769	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 50

M/V *Hugh M. Smith*: Cruise 27, 32°23'N., 166°39'W., February 14, 1955. Messenger time: 0810 GCT. Weather: 02, cloud coverage 6. Wind: 090°, 7-10 kt. Sea: 3-5 ft. Wire angle: 14°. BT slide: 153

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	15.73	34.58	25.50	5.87	0.20
42	15.74	34.61	25.53	5.79	0.18
83	15.70	34.60	25.53	5.75	0.19
124	14.39	34.70	25.89	5.63	0.43
165	13.45	34.49	25.92	5.35	0.59
211	12.65	34.45	26.05	5.30	0.73
314	11.28	34.25	26.16	5.42	0.91
423	09.95	34.16	26.32	5.15	1.18
423	10.00	34.16	26.32	-	-
525	07.98	34.04	26.54	4.38	1.70
634	06.16	33.96	26.73	3.41	2.17
845	04.24	34.11	27.07	1.24	2.96
1050	03.52	34.27	27.27	0.45	3.19
1050	03.45	34.27	27.28	-	-
1259	03.08	34.42	27.44	0.35	3.18

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	15.73	34.58	25.50	0.000	1.649
10	15.73	34.58	25.50	0.025	1.624
20	15.73	34.59	25.51	0.050	1.599
30	15.74	34.60	25.52	0.075	1.574
50	15.74	34.61	25.53	0.124	1.525
75	15.72	34.60	25.52	0.186	1.463
100	15.22	34.65	25.67	0.247	1.402
150	13.79	34.54	25.89	0.360	1.289
200	12.86	34.46	26.02	0.465	1.184
250	12.30	34.40	26.09	0.566	1.083
300	11.54	34.27	26.13	0.665	0.984
400	10.21	34.18	26.30	0.854	0.795
500	08.47	34.07	26.49	1.027	0.622
600	06.65	33.97	26.68	1.182	0.467
700	05.48	33.97	26.83	1.320	0.329
800	04.57	34.07	27.01	1.443	0.206
1000	03.64	34.23	27.23	1.649	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 51

M/V Hugh M. Smith: Cruise 27, 34°23'N., 166°36'W., February 14, 1955. Messenger time: 2055 GCT. Weather: 02, cloud coverage 8. Wind: 160°, 7-10 kt. Sea: 1-3 ft. Wire angle: 15°. BT slide: 156

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	13.98	34.43	25.77	5.89	0.38
50	13.67	34.40	25.81	5.71	0.48
101	13.22	34.42	25.92	5.34	0.67
152	12.74	34.38	25.98	5.25	0.76
208	12.17	34.34	26.06	5.26	0.84
259	11.54	34.29	26.14	5.25	0.94
309	10.77	34.23	26.24	5.18	1.06
416	09.26	34.11	26.40	5.14	1.34
517	07.50	33.98	26.56	4.37	1.83
624	05.72	33.96	26.79	3.08	2.41
831	04.18	34.16	27.12	1.24	3.08
1035	03.47	34.33	27.33	0.43	3.36
1242	02.97	34.42	27.45	0.34	3.39

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	13.98	34.43	25.77	0.000	1.555
10	13.95	34.42	25.77	0.022	1.533
20	13.93	34.42	25.77	0.045	1.510
30	13.89	34.41	25.77	0.067	1.488
50	13.67	34.40	25.81	0.112	1.443
75	13.45	34.41	25.86	0.166	1.389
100	13.25	34.42	25.91	0.220	1.335
150	12.78	34.38	25.98	0.325	1.230
200	12.23	34.34	26.05	0.427	1.128
250	11.63	34.29	26.13	0.527	1.028
300	10.90	34.25	26.23	0.622	0.933
400	09.54	34.13	26.37	0.802	0.753
500	07.85	34.00	26.53	0.969	0.586
600	06.06	33.96	26.75	1.118	0.437
700	05.02	34.02	26.92	1.248	0.307
800	04.34	34.13	27.08	1.363	0.192
1000	03.60	34.31	27.30	1.555	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 52

M/V Hugh M. Smith: Cruise 27, 35°31'N., 166°42'W., February 15, 1955. Messenger time: 0613 GCT. Weather: 02, cloud coverage 8. Wind: 180°, 10 kt. Sea: 1-3 ft. Wire angle: 12°. BT slide: 158

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	12.91	34.31	25.90	6.79	0.47
52	12.78	34.31	25.92	6.00	0.50
105	12.68	34.33	25.96	5.91	0.60
157	12.16	34.34	26.07	5.35	0.82
215	11.23	34.31	26.22	5.28	1.04
267	10.66	34.25	26.27	5.33	1.12
320	09.77	34.18	26.37	5.21	1.29
430	08.37	34.07	26.51	5.03	1.60
534	06.65	33.98	26.68	4.05	2.16
646	05.16	34.00	26.89	2.59	2.75
PT	-	-	-	-	-
1067	03.62	34.34	27.32	0.39	3.42
1067	03.55	34.34	27.33	-	-
1277	02.97	34.47	27.49	0.25	3.50

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	12.91	34.31	25.90	0.000	1.497
10	12.87	34.31	25.90	0.021	1.476
20	12.83	34.31	25.91	0.042	1.455
30	12.80	34.31	25.92	0.063	1.434
50	12.77	34.31	25.92	0.105	1.392
75	12.72	34.32	25.94	0.158	1.339
100	12.70	34.33	25.95	0.210	1.287
150	12.25	34.34	26.05	0.312	1.185
200	11.50	34.32	26.17	0.410	1.087
250	10.86	34.28	26.26	0.503	0.994
300	10.06	34.21	26.35	0.592	0.905
400	08.74	34.10	26.48	0.762	0.735
500	07.30	34.01	26.62	0.919	0.578
600	05.78	33.97	26.79	1.061	0.436
700	04.80	34.05	26.97	1.187	0.310
800	04.35	34.14	27.09	1.299	0.198
1000	03.84	34.29	27.26	1.497	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 54

M/V Hugh M. Smith: Cruise 27, 37°00'N., 166°43'W., February 15, 1955. Messenger time: 1831 GCT. Weather: 50, cloud coverage 9. Wind: 220°, 22-27 kt. Sea: 5-8 ft. Wire angle: 35°. BT slide: 161

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	12.67	34.33	25.96	5.98	0.55
47	12.41	34.31	25.99	6.06 *	0.56
95	12.41	34.29	25.98	6.00	0.62
142	12.41	34.29	25.98	5.96	0.56
190	12.20	34.31	26.04	5.71	0.72
238	11.68	34.31	26.13	5.38	0.92
285	10.94	34.23	26.21	5.35	0.99
387	09.52	34.18	26.41	5.25	1.25
485	07.70	34.02	26.57	4.86	1.65
583	06.12	33.96	26.74	3.74	2.22
775	04.40	34.07	27.03	1.69	3.00
977	03.68	34.22	27.22	0.79	3.31
977	03.63	34.22	27.22	-	-
1177	03.05	34.38	27.41	0.48	3.40

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	12.67	34.33	25.96	0.000	1.527
10	12.67	34.33	25.96	0.021	1.506
20	12.67	34.33	25.96	0.041	1.486
30	12.67	34.32	25.95	0.062	1.465
50	12.42	34.31	25.99	0.103	1.424
75	12.41	34.30	25.99	0.154	1.373
100	12.41	34.29	25.98	0.205	1.322
150	12.39	34.29	25.98	0.309	1.218
200	12.10	34.31	26.05	0.411	1.116
250	11.51	34.29	26.15	0.509	1.018
300	10.78	34.23	26.24	0.604	0.923
400	09.28	34.16	26.44	0.781	0.746
500	07.48	34.01	26.59	0.942	0.585
600	05.88	33.96	26.77	1.086	0.441
700	04.79	34.02	26.94	1.214	0.313
800	04.24	34.10	27.07	1.327	0.200
1000	03.60	34.22	27.23	1.527	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 56

M/V Hugh M. Smith: Cruise 27, 37°08'N., 164°09'W., February 16, 1955. Messenger time: 0845 GCT. Weather: 01, cloud coverage 8. Wind: 290°, 11-16 kt. Sea: 5-8 ft. Wire angle: 26°. BT slide: 164

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	12.32	34.29	26.00	6.22 *	0.53
52	12.19	34.23	25.98	6.03 *	0.57
PT	-	-	-	-	-
157	11.64	34.23	26.08	5.88	0.71
210	11.14	34.18	26.13	5.95	0.76
262	10.88	34.23	26.22	5.48	0.97
316	09.94	34.16	26.32	5.53	1.07
426	08.33	34.05	26.50	5.15	1.45
532	06.60	33.98	26.69	3.97	1.99
639	05.20	33.98	26.87	2.73	2.44
847	04.04	34.18	27.15	1.20	2.94
1058	03.37	34.31	27.32	0.49	3.16
1058	03.31	34.31	27.33	-	-
1260	02.92	34.42	27.45	0.33	3.24

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D\,1000 - \Delta D$ (dyn. m)
00	12.32	34.29	26.00	0.000	1.485
10	12.28	34.26	25.98	0.020	1.465
20	12.25	34.24	25.97	0.041	1.444
30	12.21	34.23	25.97	0.061	1.424
50	12.19	34.23	25.97	0.102	1.383
75	12.14	34.22	25.98	0.154	1.331
100	11.82	34.22	26.04	0.204	1.281
150	11.67	34.22	26.07	0.304	1.181
200	11.24	34.19	26.12	0.403	1.082
250	10.97	34.22	26.19	0.498	0.987
300	10.23	34.18	26.29	0.591	0.894
400	08.70	34.07	26.46	0.763	0.722
500	07.14	34.00	26.63	0.921	0.564
600	05.63	33.96	26.80	1.062	0.423
700	04.68	34.06	26.99	1.185	0.300
800	04.20	34.15	27.11	1.294	0.191
1000	03.50	34.28	27.29	1.485	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 57

M/V Hugh M. Smith: Cruise 27, 37°00'N., 162°16'W., February 16, 1955. Messenger time: 1924 GCT. Weather: 02, cloud coverage 3. Wind: 300°, 17-21 kt. Sea: 3-5 ft. Wire angle: 30°. BT slide: 167

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	11.34	34.16	26.08	6.25 *	0.65
46	11.26	34.16	26.09	6.15 *	0.66
92	11.20	34.14	26.09	6.16 *	0.67
139	11.04	34.14	26.12	6.21 *	0.69
190	10.96	34.13	26.13	5.48	0.72
236	10.50	34.22	26.27	5.45	1.06
283	09.94	34.18	26.34	5.30	1.12
382	08.71	34.07	26.46	4.39	1.37
474	07.24	33.98	26.60	3.35	1.86
576	05.86	33.96	26.77	1.60	2.30
769	04.39	34.07	27.03	0.81	2.94
962	03.69	34.20	27.20	0.41	3.27
1166	03.15	34.34	27.37	NS	3.35

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	11.34	34.16	26.08	0.000	1.472
10	11.32	34.16	26.08	0.019	1.453
20	11.29	34.16	26.09	0.039	1.433
30	11.27	34.16	26.09	0.058	1.414
50	11.24	34.15	26.09	0.097	1.375
75	11.22	34.14	26.09	0.146	1.326
100	11.18	34.14	26.09	0.194	1.278
150	11.01	34.13	26.12	0.292	1.180
200	10.94	34.13	26.13	0.388	1.084
250	10.35	34.21	26.30	0.482	0.990
300	09.79	34.17	26.36	0.570	0.902
400	08.52	34.06	26.48	0.738	0.734
500	06.87	33.97	26.65	0.894	0.578
600	05.62	33.97	26.81	1.033	0.439
700	04.80	34.02	26.94	1.159	0.313
800	04.22	34.10	27.07	1.272	0.200
1000	03.62	34.22	27.23	1.472	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 59

M/V Hugh M. Smith: Cruise 27, 36°57'N., 160°05'W., February 17, 1955. Messenger time: 0817 GCT. Weather: 02, cloud coverage 3. Wind: 330°, 30 kt. Sea: 5-8 ft. Wire angle: 36°. BT slide: 170

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	12.86	34.22	25.84	5.94	0.42
50	12.86	34.22	25.84	5.93	0.43
NG	-	-	-	-	-
150	12.54	34.14	25.84	6.08 *	0.54
NG	-	-	-	-	-
250	11.48	34.27	26.14	5.39	0.90
302	10.81	34.20	26.21	5.28	0.95
407	09.10	34.05	26.38	5.24	1.16
510	07.38	34.02	26.62	4.38	1.65
612	05.83	33.98	26.79	3.26	2.13
811	04.30	34.11	27.07	1.42	2.67
1017	03.53	34.25	27.26	0.55	3.01
1219	03.05	34.36	27.39	0.27	3.07

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	12.86	34.22	25.84	0.000	1.564
10	12.86	34.22	25.84	0.022	1.542
20	12.86	34.22	25.84	0.043	1.521
30	12.86	34.22	25.84	0.065	1.499
50	12.86	34.22	25.84	0.109	1.455
75	12.85	34.21	25.83	0.164	1.400
100	12.76	34.19	25.83	0.219	1.345
150	12.54	34.14	25.84	0.329	1.235
200	12.01	34.21	25.99	0.436	1.128
250	11.48	34.27	26.14	0.536	1.028
300	10.81	34.20	26.21	0.632	0.932
400	09.18	34.06	26.37	0.813	0.751
500	07.58	34.02	26.59	0.977	0.587
600	05.98	33.98	26.77	1.122	0.442
700	04.92	34.03	26.94	1.250	0.314
800	04.38	34.10	27.05	1.364	0.200
1000	03.58	34.25	27.25	1.564	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 60

M/V Hugh M. Smith: Cruise 27, 35°28'N., 159°53'W., February 17, 1955. Messenger time: 1919 GCT. Weather: 02, cloud coverage 2. Wind: 040°, 4-6 kt. Sea: 3-5 ft. Wire angle: 20°. BT slide: 173

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	12.87	34.31	25.90	6.06 *	0.41
50	12.84	34.27	25.88	5.99 *	0.42
100	12.79	34.27	25.89	5.88	0.45
149	12.21	34.16	25.92	5.99	0.49
204	11.99	34.23	26.02	5.40	0.73
254	11.20	34.23	26.16	5.42	0.87
304	10.66	34.23	26.26	5.41	0.97
410	09.10	34.09	26.41	4.96	1.27
509	07.68	34.02	26.57	4.50	1.61
614	05.81	34.00	26.81	3.11	2.18
819	04.22	34.14	27.10	1.27	2.80
1019	03.54	34.25	27.25	0.65	3.05
1019	03.49	34.25	27.26	-	-
1224	03.02	34.36	27.39	0.28	3.09

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	12.87	34.31	25.90	0.000	1.547
10	12.86	34.30	25.90	0.021	1.526
20	12.86	34.29	25.89	0.042	1.505
30	12.85	34.28	25.88	0.064	1.483
50	12.84	34.27	25.88	0.106	1.441
75	12.84	34.27	25.88	0.160	1.387
100	12.79	34.27	25.89	0.214	1.333
150	12.22	34.16	25.91	0.321	1.226
200	12.06	34.23	26.00	0.426	1.121
250	11.32	34.23	26.14	0.526	1.021
300	10.71	34.23	26.25	0.621	0.926
400	09.25	34.10	26.39	0.799	0.748
500	07.84	34.02	26.55	0.964	0.583
600	06.12	34.00	26.77	1.111	0.436
700	05.00	34.06	26.95	1.238	0.309
800	04.33	34.13	27.08	1.351	0.196
1000	03.53	34.25	27.26	1.547	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 61

M/V Hugh M. Smith: Cruise 27, 34°00'N., 159°42'W., February 18, 1955. Messenger time: 0536 GCT. Weather: 02, cloud coverage 1. Wind: 140°, 4-6 kt. Sea: 3-5 ft. Wire angle: 07°. BT slide: 176

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	14.03	34.31	25.66	5.95 *	0.32
85	13.80	34.34	25.73	5.55	0.46
128	12.89	34.34	25.92	5.18	0.70
160	12.48	34.33	26.00	5.25	0.74
219	11.69	34.29	26.12	5.35	0.82
272	11.10	34.22	26.17	5.32	0.93
326	10.43	34.22	26.29	5.21	1.01
438	09.08	34.14	26.46	4.92	1.32
545	06.70	34.00	26.69	3.78	1.94
656	05.23	33.98	26.86	2.67	2.36
874	03.95	34.18	27.16	0.87	2.94
1083	03.34	34.33	27.34	0.28	3.16
1083	03.28	34.33	27.35	-	-
1296	02.98	34.42	27.45	0.35	NG

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	14.03	34.31	25.67	0.000	1.556
10	13.85	34.34	25.73	0.023	1.533
20	13.80	34.34	25.74	0.046	1.510
30	13.80	34.34	25.74	0.069	1.487
50	13.80	34.34	25.74	0.114	1.442
75	13.80	34.34	25.74	0.171	1.385
100	13.38	34.34	25.82	0.227	1.329
150	12.61	34.34	25.98	0.334	1.222
200	11.95	34.30	26.07	0.436	1.120
250	11.33	34.25	26.15	0.534	1.022
300	10.75	34.22	26.23	0.629	0.927
400	09.60	34.17	26.39	0.808	0.748
500	07.81	34.06	26.59	0.971	0.585
600	05.87	33.98	26.79	1.116	0.440
700	04.90	34.00	26.92	1.244	0.312
800	04.27	34.10	27.06	1.359	0.197
1000	03.57	34.26	27.26	1.556	0.000

* Estimated burette reading.

Table 4.--Oceanographic station data (cont'd)

STATION 63

M/V Hugh M. Smith: Cruise 27, 32°27'N., 159°30'W., February 18, 1955. Messenger time: 1720 GCT. Weather: 02, cloud coverage 1. Wind: 140°, 4-6 kt. Sea: 3-5 ft. Wire angle: 20°. BT slide: 179

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	16.02	34.58	25.44	5.59	0.20
49	16.01	34.58	25.45	5.57	0.21
98	16.00	34.56	25.43	5.54	0.22
148	14.54	34.45	25.67	5.29	0.48
202	13.29	34.33	25.83	5.13	0.66
252	12.52	34.33	25.99	5.18	0.80
302	11.90	34.29	26.08	5.23	0.82
406	10.46	34.16	26.24	5.06	1.08
505	08.70	34.05	26.44	4.49	1.51
609	06.69	33.91	26.62	3.64	2.00
609	06.64	33.91	26.63	-	-
813	04.50	34.05	27.00	1.42	2.89
1013	03.64	34.23	27.23	0.43	3.21
1013	03.58	34.23	27.24	-	-
1218	03.08	34.38	27.40	0.31	3.23

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	16.02	34.58	25.44	0.000	1.722
10	16.01	34.58	25.44	0.025	1.697
20	16.01	34.58	25.44	0.051	1.671
30	16.01	34.58	25.44	0.077	1.645
50	16.01	34.58	25.44	0.128	1.594
75	16.02	34.57	25.43	0.192	1.530
100	15.98	34.56	25.43	0.257	1.465
150	14.52	34.45	25.67	0.380	1.342
200	13.40	34.34	25.82	0.496	1.226
250	12.55	34.33	25.98	0.604	1.118
300	11.92	34.30	26.08	0.707	1.015
400	10.58	34.18	26.23	0.901	0.821
500	08.81	34.06	26.43	1.080	0.642
600	06.85	33.92	26.61	1.241	0.481
700	05.60	33.95	26.79	1.385	0.337
800	04.60	34.04	26.98	1.510	0.212
1000	03.66	34.22	27.22	1.722	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 64

M/V Hugh M. Smith: Cruise 27, 30°59'N., 159°22'W., February 19, 1955. Messenger time: 0315 GCT. Weather: 02, cloud coverage 4. Wind: 070°, 4-6 kt. Sea: 1-3 ft. Wire angle: 06°. BT slide: 182

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	17.16	34.78	25.33	5.52	0.19
43	17.15	34.79	25.33	5.46	0.18
85	16.74	34.70	25.36	5.49	0.21
127	14.70	34.47	25.65	5.18	0.47
171	13.63	34.47 P	25.87 P	5.09	0.60
217	12.74	34.33	25.94	5.09	0.75
324	11.26	34.29	26.20	5.21	0.85
435	09.64	34.14	26.36	4.68	1.21
435	09.71	34.14	26.34	-	-
541	07.78	34.05	26.58	4.13	1.61
652	05.68	33.96	26.79	2.65	2.24
870	04.20	34.18	27.14	0.76	2.87
1080	03.57	34.34	27.32	0.32	3.05
1080	03.51	34.34	27.33	-	-
1295	03.13	34.43	27.44	0.44	3.00

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	17.16	34.78	25.33	0.000	1.674
10	17.16	34.78	25.33	0.027	1.647
20	17.16	34.78	25.33	0.053	1.621
30	17.16	34.78	25.33	0.080	1.594
50	17.05	34.76	25.34	0.133	1.541
75	16.80	34.71	25.36	0.200	1.474
100	16.58	34.67	25.38	0.266	1.408
150	14.20	34.43	25.72	0.390	1.284
200	13.07	34.35	25.89	0.502	1.172
250	12.21	34.30	26.03	0.607	1.067
300	11.54	34.28	26.14	0.708	0.966
400	10.16	34.17	26.30	0.896	0.778
500	08.52	34.08	26.49	1.069	0.605
600	06.60	33.98	26.69	1.223	0.451
700	05.21	34.00	26.88	1.358	0.316
800	04.52	34.11	27.05	1.476	0.198
1000	03.74	34.30	27.28	1.674	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 66

M/V Hugh M. Smith: Cruise 27, 29°28'N., 159°12'W., February 19, 1955. Messenger time: 1501 GCT. Weather: 02, cloud coverage 2. Wind: 120°, 11-16 kt. Sea: 3-5 ft. Wire angle: 10°. BT slide: 185

OBSERVED

DEPTH (m)	T (^{o}C)	S (^{o}/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	18.95	35.19	25.20	5.24	0.17
85	18.40	35.07	25.24	5.30	0.16
126	15.88	34.58	25.47	5.12	0.34
159	14.80	34.51	25.66	5.00	0.49
216	13.38	34.40	25.87	5.01	0.63
268	12.40	34.29	25.98	5.02	0.79
321	11.55	34.29	26.14	4.98	0.89
430	09.91	34.18	26.34	4.69	1.20
534	07.70	34.05	26.59	3.89	1.72
644	05.76	34.02	26.84	2.43	2.32
856	04.30	34.18	27.12	0.74	2.93
1062	03.66	34.34	27.32	0.36	3.11
1273	03.23	34.49	27.48	0.72	2.98

INTERPOLATED AND CALCULATED

DEPTH (m)	T (^{o}C)	S (^{o}/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	18.95	35.19	25.20	0.000	1.691
10	18.95	35.19	25.20	0.028	1.663
20	18.94	35.18	25.19	0.056	1.635
30	18.94	35.18	25.19	0.084	1.607
50	18.80	35.15	25.21	0.139	1.552
75	18.50	35.09	25.24	0.209	1.482
100	17.60	34.88	25.30	0.277	1.414
150	15.08	34.53	25.61	0.406	1.285
200	13.75	34.44	25.83	0.523	1.168
250	12.70	34.32	25.95	0.632	1.059
300	11.87	34.29	26.08	0.735	0.956
400	10.36	34.20	26.29	0.927	0.764
500	08.49	34.09	26.51	1.100	0.591
600	06.20	34.02	26.78	1.249	0.442
700	05.18	34.06	26.93	1.378	0.313
800	04.62	34.13	27.05	1.493	0.198
1000	03.80	34.32	27.29	1.691	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 67

M/V Hugh M. Smith: Cruise 27, 28°00'N., 159°03'W., February 20, 1955. Messenger time: 0204 GCT. Weather: 02, cloud coverage 6. Wind: 070°, 17-21 kt. Sea: 5-8 ft. Wire angle: 20°. BT slide: 188

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
0	20.91	35.39	24.83	5.12	0.14
57	20.19	35.28	24.94	5.11	0.15
113	19.08	35.05	25.06	5.23	0.17
170	16.00	34.61	25.47	5.05	0.43
226	14.40	34.43	25.68	5.03	0.55
282	13.44	34.36	25.83	4.97	0.71
340	12.04	34.29	26.05	4.99	0.86
458	09.38	34.13	26.39	4.54	1.33
572	07.08	34.13	26.74	3.45	1.95
684	05.54	34.07	26.89	2.02	2.51
904	04.22	34.31	27.24	0.58	3.01
1124	03.54	34.51	27.46	0.63	3.13
1334	03.09	34.49	27.49	1.01	2.93

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	20.91	35.39	24.83	0.000	1.769
10	20.90	35.39	24.84	0.031	1.738
20	20.88	35.39	24.84	0.062	1.707
30	20.88	35.39	24.84	0.094	1.675
50	20.39	35.32	24.92	0.156	1.613
75	19.79	35.20	24.99	0.231	1.538
100	19.39	35.11	25.02	0.306	1.463
150	17.77	34.85	25.23	0.451	1.318
200	14.94	34.48	25.60	0.582	1.187
250	14.00	34.40	25.74	0.701	1.068
300	13.10	34.34	25.88	0.815	0.954
400	10.58	34.20	26.25	1.018	0.751
500	08.43	34.12	26.54	1.191	0.578
600	06.65	34.12	26.79	1.338	0.431
700	05.38	34.08	26.92	1.467	0.302
800	04.65	34.21	27.11	1.580	0.189
1000	03.98	34.39	27.33	1.769	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 69

M/V *Hugh M. Smith*: Cruise 27, 26°30'N., 158°47'W., February 20, 1955. Messenger time: 1424 GCT. Weather: 02, cloud coverage 2. Wind: 070°, 17-21 kt. Sea: 5-8 ft. Wire angle: 25°. BT slide: 191

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σt	O_2 (ml/l)	PO_4-P (μg at/l)
0	21.61	35.43	24.67	5.03	0.13
42	21.60	35.37	24.63	5.01	0.12
84	21.25	35.41	24.75	5.00	0.14
121	19.53	35.12	24.99	4.79	0.26
162	17.75	34.87	25.25	4.66	0.37
207	16.18	34.69	25.49	4.80	0.44
310	12.12	34.18	25.95	4.64	0.84
419	09.75	34.13	26.33	4.57	1.11
419	09.95	34.13	26.30	-	-
523	07.44	34.07	26.64	3.72	1.79
627	06.18	34.00	26.76	2.60	2.27
833	04.44	34.18	27.11	0.75	2.94
1041	03.76	34.42	27.37	0.69	3.08
1243	03.30	34.49	27.47	1.03	2.94

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σt	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	21.61	35.43	24.67	0.000	1.808
10	21.61	35.42	24.67	0.033	1.775
20	21.60	35.40	24.65	0.066	1.742
30	21.60	35.38	24.64	0.099	1.709
50	21.52	35.37	24.65	0.165	1.643
75	21.27	35.41	24.75	0.247	1.561
100	21.15	35.40	24.78	0.328	1.480
150	18.35	34.95	25.17	0.480	1.328
200	16.38	34.71	25.46	0.616	1.192
250	13.58	34.33	25.78	0.738	1.070
300	12.27	34.20	25.94	0.849	0.959
400	10.23	34.14	26.26	1.050	0.758
500	07.88	34.09	26.60	1.219	0.589
600	06.46	34.00	26.73	1.366	0.442
700	05.35	34.05	26.90	1.498	0.310
800	04.65	34.14	27.06	1.615	0.193
1000	03.86	34.38	27.33	1.808	0.000

Table 4.--Oceanographic station data (cont'd)

STATION 70

M/V *Hugh M. Smith*: Cruise 27, 25°00'N., 158°40'W., February 21, 1955. Messenger time: first cast 0155 GCT, second cast 0224 GCT. Weather: 15, cloud coverage 6. Wind: 060°, 17-21 kt. Sea: 8-12 ft. Wire angle: first cast 05°, second cast 06°. BT slide: 194

OBSERVED

	DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (µg at/l)
	0	21.55	35.41	24.67	5.05	0.13
	59	20.94	35.39	24.82	5.08	0.14
	117	19.55	35.12	24.99	4.78	0.23
	175	17.92	34.92	25.25	4.75	0.34
	234	15.26	34.58	25.61	4.62	0.52
	292	12.84	34.45	26.02	4.81	0.79
I	351	11.06	34.33	26.26	4.65	1.01
	471	08.43	34.07	26.50	4.17	1.77
	587	06.31	34.04	26.78	2.68	2.24
	699	04.94	34.13	27.02	1.21	2.83
	384	10.10	34.16	26.30	4.52	1.36
II	624	05.56	34.09	26.91	1.73	2.70
	850	04.41	34.31	27.22	0.90	3.01

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	$\Delta D_{1000} - \Delta D$ (dyn. m)
00	20.95	35.41	-	-	-
10	20.95	35.41	-	-	-
20	20.95	35.40	-	-	-
30	20.96	35.40	-	-	-
50	20.98	35.39	-	-	-
75	20.30	35.26	-	-	-
100	19.85	35.17	-	-	-
150	18.72	35.02	-	-	-
200	17.04	34.77	-	-	-
250	14.58	34.54	-	-	-
300	12.61	34.44	-	-	-
400	09.81	34.14	-	-	-
500	07.93	34.05	-	-	-
600	06.01	34.05	-	-	-
700	04.94	34.13	-	-	-
800	04.60	34.21	-	-	-

Table 4.--Oceanographic station data (cont'd)

STATION 72

M/V Hugh M. Smith: Cruise 27, 23°29'N., 158°27'W., February 21, 1955. Messenger time: 1506 GCT. Weather: 02, cloud coverage 2. Wind: 200°, 4-6 kt. Sea: 1-3 ft. Wire angle: 20°. BT slide: 197

OBSERVED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	O_2 (ml/l)	PO_4-P (μg at/l)
0	22.41	35.21	24.28	5.04	0.24
40	22.39	35.21	24.29	4.88	0.22
79	22.34	35.17	24.27	4.88	0.24
118	22.34	35.21	24.30	4.89	0.24
159	21.64	35.26	24.53	4.69	0.23
203	19.64	35.12	24.96	4.68	0.29
302	14.23	34.42	25.71	4.50	0.71
405	09.88	34.14	26.32	3.81	1.57
505	08.02	34.16	26.63	2.54	2.23
609	06.38	34.20	26.90	1.43	2.64
814	04.60	34.25	27.15	0.79	3.07
1013	03.97	34.43	27.36	1.03	3.16
1013	03.92	34.43	27.36	-	-
1218	03.46	34.52	27.48	1.28	3.06

INTERPOLATED AND CALCULATED

DEPTH (m)	T (°C)	S (°/oo)	σ_t	ΔD (dyn. m)	ΔD 1000 - ΔD (dyn. m)
00	22.41	35.21	24.28	0.000	1.920
10	22.39	35.21	24.29	0.037	1.883
20	22.39	35.21	24.29	0.073	1.847
30	22.39	35.21	24.29	0.110	1.810
50	22.38	35.20	24.28	0.183	1.737
75	22.34	35.17	24.27	0.275	1.645
100	22.34	35.20	24.29	0.367	1.553
150	22.01	35.25	24.42	0.548	1.372
200	19.78	35.13	24.94	0.715	1.205
250	17.99	34.92	25.23	0.863	1.057
300	14.37	34.44	25.70	0.993	0.927
400	10.02	34.15	26.31	1.203	0.717
500	08.08	34.16	26.62	1.369	0.551
600	06.49	34.20	26.88	1.508	0.412
700	05.48	34.21	27.01	1.628	0.292
800	04.66	34.24	27.13	1.736	0.184
1000	03.95	34.42	27.35	1.920	0.000

27, January 5 to February 21, 1955 (For coded values see H. O. Pub 606-C)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
1	1840	1/6	22°34'N	159°38'W	76.0	130	08	74.5	69.0	1016.4	02	8	3	8	3
2	0200	1/7	22°53'N	160°17'W	75.0	320	06	76.5	70.5	1013.4	03	8	6	7	3
3	0610	1/7	23°10'N	160°51'W	74.1	050	19	74.0	68.5	1014.4	02	8	7	7	3
4	1200	1/7	23°36'N	161°43'W	74.2	090	22	73.0	69.0	1014.4	02	8	8	7	3
5	1805	1/7	23°52'N	162°28'W	74.7	170	15	73.5	67.5	1013.8	02	8	3	9	3
6	2330	1/8	23°52'N	162°30'W	74.7	170	17	75.5	70.5	1014.0	02	8	1	9	3
7	0230	1/8	23°47'N	163°01'W	74.8	170	18	75.5	70.5	1013.6	02	8	2	9	3
8	0630	1/8	23°37'N	163°33'W	74.9	170	15	74.4	70.8	1015.4	02	8	2	9	3
9	1100	1/8	23°31'N	164°07'W	74.7	190	27	71.0	70.0	1016.0	50	8	6	8	3
10	1600	1/8	23°14'N	165°00'W	74.1	140	15	73.6	70.9	1016.1	01	8	3	9	2
11	2300	1/8	22°59'N	165°47'W	75.9	180	12	76.5	72.0	1016.7	03	8	4	9	2
12	0300	1/9	22°49'N	166°21'W	76.3	150	08	76.0	71.0	1016.4	01	3	2	9	2
13	0800	1/9	22°39'N	166°59'W	76.0	180	08	75.1	71.5	1017.9	02	8	3	9	2
14	1138	1/9	22°29'N	167°30'W	75.9	120	18	74.8	71.2	1019.2	02	8	2	9	2
15	1755	1/9	22°22'N	168°09'W	76.1	150	10	75.0	72.0	1017.4	02	8	2	9	3
16	2215	1/9	21°51'N	168°46'W	77.0	180	16	77.1	73.0	1018.1	02	8	3	8	3
17	0255	1/10	21°44'N	169°27'W	76.8	180	11	76.2	72.0	1016.5	18	8	4	8	3
18	0600	1/10	21°38'N	170°20'W	76.9	190	07	76.5	72.5	1017.5	02	8	2	9	3
19	1200	1/10	21°25'N	170°48'W	77.2	210	05	77.0	72.5	1017.6	02	3	1	9	3
20	1545	1/10	21°10'N	171°16'W	77.9	190	07	77.0	72.0	1017.6	01	1	1	9	3
21	1950	1/10	20°55'N	171°46'W	76.4	000	24	75.1	71.0	1020.5	14	0,8	5	8	3
22	2305	1/10	20°39'N	172°17'W	76.2	020	20	74.0	70.0	1019.2	62	0,8	5	8	4
23	0545	1/11	20°33'N	173°01'W	75.2	030	27	74.5	69.5	1020.4	02	4,8	8	7	5
24	0945	1/11	20°27'N	173°32'W	75.1	030	29	74.1	66.1	1021.4	02	8	8	7	5
25	1350	1/11	20°20'N	174°11'W	75.5	050	35	72.5	65.5	1022.0	03	8	8	7	5
26	1800	1/11	20°15'N	174°43'W	76.6	080	32	72.0	64.8	1023.4	02	7	8	7	5-6
27	2200	1/11	20°26'N	175°15'W	76.8	050	30	74.5	64.5	1025.2	02	8	5	9	5-6
28	0130	1/12	20°33'N	175°50'W	76.8	080	31	74.0	65.0	1023.0	01	8	3	9	5
29	0505	1/12	20°37'N	176°20'W	76.5	070	27	73.5	64.5	1023.9	02	8	8	8	5
30	0910	1/12	20°48'N	176°57'W	76.6	080	24	73.0	65.4	1024.0	02	8	3	9	5

Table 5.--Summary of observations at bathythermograph lowerings, Hugh M. Smith cruise 27, January 5 to February 21, 1955 (For coded values see H. O. Pub 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
31	1200	1/12	20°53'N	177°13'W	76.8	080	18	73.5	65.0	1023.4	02	8	7	9	4
32	1800	1/12	20°50'N	177°23'W	76.0	070	22	73.5	66.0	1023.9	02	8	3	9	4
33	2330	1/12	21°03'N	177°54'W	77.5	080	18	75.1	66.5	1022.9	02	8	8	8	4
34	0330	1/13	21°15'N	178°26'W	76.5	090	25	75.0	67.5	1022.4	02	8	7	9	4
35	0650	1/13	21°28'N	179°05'W	77.2	080	20	74.8	66.1	1023.3	02	8	5	9	4
36	1015	1/13	21°40'N	179°31'W	77.0	090	13	76.0	68.5	1023.4	02	8	4	9	3
37	1315	1/13	21°51'N	180°00'	76.7	090	20	74.0	66.9	1022.0	02	8	3	9	X
38	1715	1/13	21°56'N	179°33'E	76.5	090	20	75.5	67.5	1023.0	02	8	3	9	3
39	2130	1/13	22°00'N	178°52'E	76.2	090	16	76.1	67.0	1022.7	02	8	7	9	3
40	0155	1/14	22°09'N	178°08'E	77.2	090	12	78.0	68.0	1019.7	02	8	7	9	2
41	0630	1/14	22°31'N	177°30'E	76.4	090	18	75.2	66.5	1020.4	02	6	9	8	3
42	1230	1/14	22°45'N	176°47'E	76.1	070	08	75.1	66.1	1020.4	02	6	9	8	3
43	1615	1/14	22°57'N	176°10'E	75.8	050	11	75.5	66.5	1019.0	02	6	7	8	3
44	2020	1/14	23°08'N	175°21'E	76.4	040	11	75.5	66.5	1020.9	01	6	7	9	3
45	0005	1/15	23°19'N	174°46'E	75.0	080	13	75.0	66.5	1018.0	01	2	1	9	3
46	0550	1/15	23°33'N	174°03'E	76.0	020	09	76.5	67.0	1017.9	02	6	2	9	3
47	1020	1/15	23°49'N	173°30'E	75.0	020	19	71.5	67.4	1019.9	02	6	3	9	5
48	1315	1/15	23°57'N	173°00'E	75.2	260	09	66.5	66.0	1020.0	51	8	9	0	5
49	1630	1/15	23°57'N	172°38'E	76.2	060	30	70.0	65.8	1020.0	03	8	8	3	5
50	2210	1/15	24°03'N	172°09'E	75.9	060	26	73.0	67.0	1023.4	02	8	8	8	5
51	0200	1/16	24°17'N	171°37'E	76.5	030	33	74.0	65.0	1023.0	03	6	7	8	5
52	0600	1/16	24°34'N	171°05'E	76.3	080	31	71.5	63.0	1022.5	01	6	3	9	5
53	1100	1/16	24°50'N	170°31'E	73.0	070	19	71.5	63.0	1024.9	02	6	4	9	4
54	1440	1/16	24°59'N	169°31'E	72.2	080	21	71.1	63.1	1023.4	02	8	3	9	3
55	1930	1/16	25°25'N	169°30'E	71.4	090	26	70.2	64.0	1023.9	01	8	7	9	3
56	2300	1/16	25°56'N	169°28'E	72.0	100	18	73.0	64.0	1025.4	02	4, 8	7	9	3
57	0300	1/17	26°29'N	169°32'E	71.0	100	18	76.0	65.0	1024.0	02	8	1	9	3
58	0755	1/17	27°02'N	169°39'E	70.5	140	14	69.9	62.5	1024.8	02	X	0	9	3
59	1200	1/17	27°30'N	169°49'E	70.1	120	07	70.0	62.2	1025.4	02	X	0	9	3
60	1515	1/17	27°55'N	169°50'E	70.0	130	10	69.0	61.0	1024.7	02	X	0	9	3

Table [illegible]. Summary of observations at bathythermograph lowerings, *Hugh M. Smith* cruise 27, January 5 to February 21, 1955 (For coded values see H. O. Pub 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visi-bili-ty	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
61	2115	1/17	28°25'N	169°50'E	70.5	000	05	69.0	62.0	1024.9	02	6	1	9	3
62	0120	1/18	29°00'N	169°53'E	71.5	200	10	69.5	64.7	1022.4	02	6	6	9	3
63	0505	1/18	29°30'N	169°56'E	70.9	250	16	69.4	65.1	1021.8	02	4, 8	5	9	3
64	1030	1/18	30°00'N	170°05'E	68.4	230	14	68.2	65.2	1021.1	02	1	5	9	3
65	1350	1/18	30°33'N	170°22'E	66.0	260	18	67.0	66.0	1020.0	02	X	X	9	4
66	1720	1/18	31°05'N	170°34'E	67.4	270	20	66.4	64.9	1018.0	02	4, 8	5	9	3
67	2215	1/18	31°31'N	170°46'E	65.0	270	15	65.2	62.2	1018.4	02	4, 8	5	9	3
68	0130	1/19	32°00'N	170°37'E	63.4	280	25	65.1	62.5	1016.2	02	4	4	9	3
69	2325	1/19	32°41'N	171°20'E	62.0	330	16	56.1	50.0	1024.4	02	8	3	9	3
70	0405	1/20	32°28'N	171°55'E	64.0	350	16	56.5	51.5	1024.1	02	8	5	9	5
71	1200	1/20	32°08'N	172°50'E	63.9	090	05	58.0	50.0	1026.4	02	X	3	9	4
72	1800	1/20	31°56'N	173°29'E	63.5	190	12	59.0	49.5	1025.0	01	4	4	9	4
73	0000	1/21	31°45'N	174°00'E	65.8	140	15	61.0	53.0	1024.9	02	6	4	9	4
74	0600	1/21	31°37'N	174°35'E	64.5	160	25	62.9	55.6	1021.5	02	8	7	9	4
75	1200	1/21	31°30'N	175°10'E	63.5	190	30	63.5	56.0	1020.4	02	X	4	9	5
76	1800	1/21	31°23'N	175°45'E	65.5	190	33	66.0	61.5	1016.6	01	X	3	9	5
77	0000	1/22	31°15'N	176°20'E	65.8	210	32	68.0	64.0	1014.9	02	6	8	7	5
78	0600	1/22	30°58'N	176°52'E	66.5	240	23	66.8	65.1	1015.5	63	0	9	5	5
79	1200	1/22	30°43'N	177°23'E	66.0	250	04	65.0	63.5	1018.4	51	X	9	7	3
80	1800	1/22	30°26'N	177°54'E	66.0	190	20	67.0	65.0	1018.4	02	X	9	7	3
81	0000	1/23	30°09'N	178°27'E	65.5	200	15	68.0	65.1	1018.8	01	6	8	8	3
82	0600	1/23	29°55'N	178°58'E	66.2	210	20	66.0	65.8	1017.5	46	8	9	1	3
83	1200	1/23	29°42'N	179°28'E	66.0	240	23	67.0	66.1	1018.9	46	X	9	4	3
84	1900	1/23	29°15'N	179°42'W	68.0	200	20	68.0	67.0	1019.0	01	3	6	9	4
85	0000	1/24	29°09'N	179°07'W	67.5	240	15	70.1	67.2	1018.9	02	6	2	9	4
86	0600	1/24	28°46'N	178°46'W	68.0	280	16	70.0	64.5	1019.4	03	4, 6	7	9	4
87	1200	1/24	28°27'N	178°10'W	69.5	270	16	69.8	63.0	1020.9	02	X	2	9	3
88	1200	2/1	28°39'N	178°32'W	69.0	290	11	78.0	78.2	1016.4	02	8	5	9	3
89	1800	2/1	28°59'N	179°19'W	68.0	270	10	70.0	68.0	1014.7	50	X	9	0	2
90	0000	2/2	29°19'N	179°54'E	67.0	290	07	64.0	61.0	1015.4	51	0	9	7	3

Table 5.--Summary of observations at bathythermograph lowerings, Hugh M. Smith cruise 27, January 5 to February 21, 1955 (For coded values see H. O. Pub 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
91	0320	2/2	29°31'N	179°20'E	65.9	220	18	64.2	61.8	1013.3	61	6	8	7	3
92	0845	2/2	30°00'N	179°31'E	66.3	280	15	64.8	59.5	1014.7	21	6	8	8	3
93	1340	2/2	30°52'N	179°41'E	65.5	330	10	64.0	59.5	1014.0	01	4	3	7	3
94	1725	2/2	31°08'N	179°52'E	65.5	320	10	62.8	55.8	1014.3	02	4, 6	6	9	3
95	2115	2/2	31°33'N	179°53'E	64.6	280	10	63.0	56.5	1015.4	02	3	6	9	3
96	0044	2/3	32°01'N	179°50'E	65.0	280	10	64.0	58.5	1014.4	03	6	8	8	3
97	0350	2/3	32°34'N	179°56'W	64.8	290	19	62.0	56.0	1014.6	15	5, 6	7	9	4
98	1030	2/3	32°59'N	179°57'W	62.0	330	34	57.0	53.0	1017.4	02	6	9	8	5
99	1445	2/3	33°27'N	180°00'	62.5	330	30	55.5	50.0	1017.8	03	8	6	8	5
100	1810	2/3	33°49'N	179°56'E	62.0	330	30	54.5	50.0	1020.0	02	8	3	9	5
101	0015	2/4	34°25'N	179°52'E	62.5	000	29	54.0	47.0	1023.0	02	8	5	8	6
102	0810	2/4	35°08'N	179°51'E	56.0	030	22	54.0	46.5	1027.4	03	8	6	8	5
103	1230	2/4	35°30'N	179°44'W	60.0	030	24	53.0	45.8	1028.4	02	6	8	8	5
104	1805	2/4	36°25'N	179°25'E	57.0	030	18	55.0	47.5	1031.0	03	8	7	7	5
105	2010	2/4	36°43'N	179°28'E	58.2	060	21	49.8	44.7	1031.8	02	4	4	9	5
106	0215	2/5	36°49'N	179°43'W	60.5	050	22	51.8	47.0	1033.4	02	8	3	9	5
107	0735	2/5	36°58'N	178°47'W	57.6	090	20	51.5	45.5	1034.0	02	8	3	9	5
108	1315	2/5	37°13'N	177°40'W	58.0	050	15	53.5	47.0	1037.0	02	8	5	8	5
109	1900	2/5	37°12'N	177°07'W	57.9	060	20	51.5	46.5	1035.9	02	8	3	9	5
110	0000	2/6	37°06'N	176°11'W	57.2	100	18	52.8	46.9	1036.8	02	8	3	9	5
111	0405	2/6	37°00'N	175°32'W	58.2	120	16	51.4	46.9	1035.9	02	8, 4, 1	4	9	4
112	1100	2/6	36°56'N	174°47'W	55.7	140	10	50.5	46.2	1037.6	02	8	2	9	3
113	1500	2/6	36°52'N	174°05'W	53.5	120	10	50.0	45.5	1037.4	02	8	2	9	3
114	1915	2/6	36°49'N	173°20'W	53.0	080	20	52.9	46.9	1036.0	02	6	2	9	3
115	0000	2/7	36°21'N	173°20'W	55.0	110	22	52.1	46.7	1034.9	02	6	9	9	3
116	0330	2/7	35°48'N	173°24'W	56.0	140	20	53.0	47.1	1033.4	02	7	9	9	4
117	0630	2/7	35°20'N	173°27'W	57.1	140	19	52.8	47.2	1032.9	02	7	7	9	4
118	1200	2/7	34°52'N	173°22'W	57.5	130	23	54.8	49.4	1031.0	02	7	8	9	4
119	1540	2/7	34°27'N	173°17'W	58.0	150	24	55.0	49.0	1029.4	02	6	8	8	4
120	1715	2/7	34°09'N	173°13'W	58.0	180	19	57.0	52.0	1029.4	02	0	8	8	3

January 5 to February 21, 1955 (For coded values see H. O. Pub 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
121	2220	2/7	33°42'N	173°08'W	58.0	180	17	59.0	52.5	1028.9	02	0	8	8	3
122	0130	2/8	33°20'N	173°04'W	59.0	150	22	60.5	54.5	1026.0	02	0	8	8	4
123	0820	2/8	32°30'N	173°02'W	61.1	190	16	60.8	55.4	1027.6	01	5	8	9	3
124	1245	2/8	32°00'N	173°02'W	61.1	180	17	62.0	57.0	1026.4	01	6	7	9	3
125	1640	2/8	31°33'N	173°03'W	61.0	160	13	62.0	56.5	1025.4	02	6	6	9	2
126	1950	2/8	31°00'N	172°57'W	65.0	140	1*	64.0	57.0	1027.4	02	6	8	9	2
127	2345	2/8	30°33'N	172°52'W	62.0	140	2*	64.0	57.0	1027.0	01	8	1	9	2
128	0330	2/9	30°07'N	172°47'W	62.9	130	3*	63.0	57.5	1024.7	02	8	1	9	3
129	0820	2/9	29°35'N	172°42'W	63.2	080	3*	62.8	57.1	1026.6	02	8	2	9	2
130	1310	2/9	29°04'N	172°42'W	66.0	080	3*	64.2	58.6	1026.0	03	8	6	9	3
131	1650	2/9	28°21'N	172°40'W	67.5	080	5*	64.0	57.5	1024.4	03	8	7	8	3
132	1920	2/9	28°00'N	172°37'W	68.0	080	4*	67.0	59.0	1025.9	01	6	8	9	3
133	0030	2/10	27°31'N	172°24'W	70.0	100	4*	68.0	60.0	1025.0	03	6	7	9	4
134	0420	2/10	27°02'N	172°13'W	70.2	110	5*	68.0	58.9	1024.4	02	8	6	9	4
135	0800	2/10	26°32'N	171°57'W	70.8	090	5*	68.1	61.0	1025.3	02	8	3	9	4
136	1030	2/11	26°06'N	171°21'W	69.9	050	5*	67.5	61.5	1025.4	01	8	4	9	4
137	1430	2/11	26°27'N	170°57'W	70.0	050	5*	67.0	60.5	1024.4	02	8	4	9	4
138	1810	2/11	26°47'N	170°34'W	69.0	050	5*	64.5	62.0	1025.9	03	8	6	7	4
139	2210	2/11	27°05'N	170°07'W	68.7	050	5*	69.0	61.0	1027.1	03	8	7	9	4
140	0215	2/12	27°24'N	169°40'W	68.0	040	5*	67.0	61.5	1025.9	02	7	8	8	4
141	0600	2/12	27°43'N	169°13'W	67.3	050	7*	66.2	58.9	1027.1	02	7	8	9	5
142	1000	2/12	28°00'N	168°42'W	67.0	050	5*	65.5	58.5	1029.9	01	8	3	9	4
143	1545	2/12	28°19'N	168°13'W	68.5	050	5*	64.0	57.0	1027.4	02	8	4	9	4
144	2010	2/12	28°37'N	167°47'W	68.0	050	5*	65.5	58.0	1029.8	01	8	3	9	4
145	2345	2/12	28°58'N	167°15'W	68.0	080	5*	65.8	58.0	1029.4	02	8	3	9	4
146	0250	2/13	29°14'N	166°48'W	67.0	080	5*	67.5	60.0	1029.0	02	8	3	9	4
147	0505	2/13	29°30'N	166°44'W	66.8	080	5*	64.0	58.5	1030.1	02	8	2	9	4
148	1110	2/13	30°00'N	166°42'W	66.9	040	5*	61.8	57.8	1031.0	02	8	2	9	4
149	1445	2/13	30°30'N	166°46'W	66.1	040	4*	61.5	56.5	1030.4	03	8	4	9	3
150	1830	2/13	30°57'N	166°49'W	66.0	090	3*	59.0	54.9	1031.4	02	8	4	9	3

* Anemometer failed; Beaufort force

Table 5.--Summary of observations at bathythermograph lowerings, Hugh M. Smith cruise 27, January 5 to February 21, 1955(For coded values see H. O. Pub 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
151	2325	2/13	31°32'N	166°46'W	62.3	090	3*	65.0	57.0	1031.0	01	8	2	9	3
152	0305	2/14	32°00'N	166°45'W	62.0	090	3*	61.0	56.0	1029.9	03	8	4	9	3
153	0710	2/14	32°27'N	166°40'W	60.0	120	3*	59.1	55.1	1032.9	02	7,8	6	9	3
154	1240	2/14	33°00'N	166°40'W	59.8	140	3*	60.2	55.5	1030.2	02	7,8	6	9	3
155	1615	2/14	33°48'N	166°39'W	58.3	120	2*	62.0	57.0	1029.1	03	7,8	8	8	2
156	1945	2/14	34°22'N	166°37'W	57.6	160	2*	60.1	56.0	1028.9	02	0	8	8	2
157	0100	2/15	34°54'N	166°38'W	56.5	140	2*	60.0	57.0	1027.4	03	0	8	9	2
158	0515	2/15	35°30'N	166°40'W	55.1	180	3*	57.5	55.3	1025.5	02	6	8	9	2
159	1050	2/15	36°01'N	166°44'W	55.1	210	4*	56.8	55.2	1021.6	02	X	8	8	3
160	1415	2/15	36°32'N	166°43'W	55.0	220	4*	56.5	55.5	1019.4	61	X	9	4	3
161	1725	2/15	37°00'N	166°43'W	54.9	220	6*	57.0	56.0	1016.4	50	0	9	7	4
162	2310	2/15	37°02'N	166°00'W	54.2	220	5*	56.0	55.0	1016.4	50	X	9	5	4
163	0320	2/16	37°05'N	165°00'W	54.0	270	4*	55.0	53.0	1016.4	45	X	9	1	4
164	0740	2/16	37°07'N	164°11'W	54.4	290	4*	53.3	50.5	1018.0	01	0	8	8	4
165	1215	2/16	37°07'N	163°36'W	53.1	300	3*	53.5	49.5	1019.1	02	0	7	9	3
166	1520	2/16	37°04'N	162°55'W	53.0	290	3*	54.0	50.5	1018.4	01	4	3	9	2
167	1820	2/16	37°00'N	162°20'W	52.1	300	5*	53.0	49.5	1018.9	02	8	3	9	3
168	2340	2/16	36°59'N	161°31'W	54.0	330	5*	50.2	46.2	1021.6	01	4,8	4	9	4
169	0330	2/17	37°00'N	160°46'W	55.0	330	5*	50.0	44.0	1023.1	02	4,8	4	9	4
170	0710	2/17	36°56'N	160°05'W	54.8	330	5*	49.4	43.5	1024.2	02	8	3	9	4
171	1155	2/17	36°30'N	160°01'W	54.8	270	3*	49.8	44.2	1024.1	02	8	3	9	4
172	1500	2/17	36°00'N	159°57'W	54.2	280	2*	51.0	45.0	1024.9	01	4	2	9	3
173	1815	2/17	35°30'N	159°53'W	55.0	040	2*	51.0	45.0	1026.9	02	1,2	2	9	3
174	2205	2/17	35°00'N	159°50'W	57.0	120	2*	54.0	47.0	1027.4	01	4	1	9	3
175	0115	2/18	34°30'N	159°47'W	57.5	120	2*	53.0	47.0	1026.0	02	4	1	9	3
176	0435	2/18	34°00'N	159°42'W	57.0	140	2*	53.1	48.5	1025.8	02	1,4	1	9	3
177	0945	2/18	33°30'N	159°39'W	60.3	120	3*	54.9	50.5	1026.4	02	4	1	9	3
178	1255	2/18	33°00'N	159°35'W	60.8	120	3*	56.0	51.5	1026.9	02	4	1	9	3
179	1615	2/18	32°27'N	159°30'W	60.0	140	2*	57.5	51.9	1026.9	02	4	1	9	3
180	2045	2/18	31°52'N	159°28'W	61.5	140	2*	61.0	55.0	1027.3	03	4,8	2	9	3

* Anemometer failed; Beaufort force

Summary of observations at bathythermograph lowerings, Hugh M. Smith cruise 27, January 5 to February 21, 1955(For coded values see H. O. Pub 606-C) (cont'd)

Ser. No.	Time, GCT	Date, 1955	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover		
181	2330	2/18	31°28'N	159°25'W	63.5	140	4*	61.5	55.5	1024.9	02	1,4	3	9	3
182	0215	2/19	31°00'N	159°22'W	62.9	070	2*	61.2	56.0	1025.0	02	1	4	9	2
183	0730	2/19	30°30'N	159°18'W	65.0	080	4*	63.0	57.5	1027.9	02	1	2	9	3
184	1055	2/19	30°00'N	159°15'W	66.0	090	3*	64.5	58.2	1026.7	02	1	2	8	3
185	1400	2/19	29°30'N	159°12'W	65.5	120	4*	65.0	57.0	1024.9	02	X	2	8	3
186	1830	2/19	29°00'N	159°89'W	66.5	120	3*	66.0	60.5	1025.6	03	4,8	6	8	3
187	2150	2/19	28°28'N	159°05'W	67.5	120	5*	68.5	64.0	1024.4	03	4,8	8	8	4
188	0055	2/20	28°00'N	159°03'W	69.6	080	5*	68.2	63.2	1021.9	02	8	6	8	4
189	0605	2/20	27°30'N	158°56'W	69.2	080	5*	68.0	63.0	1022.5	02	8	6	8	4
190	0945	2/20	27°00'N	158°53'W	70.0	080	5*	69.0	63.5	1021.4	01	8	4	9	4
191	1320	2/20	26°30'N	158°47'W	70.0	070	5*	69.0	63.0	1018.4	02	X	2	9	4
192	1810	2/20	26°03'N	158°45'W	70.5	070	5*	67.5	65.0	1018.0	50	8	7	8	4
193	2140	2/20	25°30'N	158°43'W	71.5	070	4*	70.5	67.5	1016.9	50	6	8	7	4
194	0100	2/21	25°00'N	158°40'W	70.0	060	5*	70.5	67.3	1012.6	15	6	6	8	5
195	0455	2/21	24°39'N	158°35'W	71.0	060	2*	70.3	68.2	1011.7	01	6	5	8	5
196	1055	2/21	24°00'N	158°28'W	72.0	090	3*	71.0	68.0	1010.9	02	6	2	9	3
197	1400	2/21	23°30'N	158°27'W	72.0	200	2*	71.0	67.0	1008.9	02	X	2	9	2
198	1850	2/21	23°00'N	158°24'W	72.0	200	2*	79.8	68.2	1000.1	16	8	4	9	3

* Anemometer failed; Beaufort force

Table 6.--Log of ship's weather observations, Hugh M. Smith cruise 27, January 5 to February 21, 1955. Results in International Ship's Weather Code, January 1955

Date, 1955	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
1/7	22.9°N	160.1°W	0000	98	00	00	03	0	1013.8	8	0.6	78.8	69.0	76.2	4	3	3	6	1	0	09	3	3
1/7	23.2°N	160.9°W	0600	97	05	19	03	2	1014.4	1	1.0	74.0	68.5	74.1	8	8	4	5	X	X	05	X	4
1/7	23.6°N	161.7°W	1200	97	09	22	02	2	1014.4	0	0.4	73.0	69.0	74.2	8	8	0	5	X	X	09	X	4
1/7	23.9°N	162.4°W	1800	99	17	15	02	1	1013.8	3	1.6	73.5	67.5	74.7	4	4	3	4	0	0	09	3	4
1/8	23.1°N	162.5°W	0000	99	17	17	01	1	1014.0	0	2.4	75.5	70.5	74.7	1	1	0	4	0	0	19	3	4
1/8	23.8°N	162.4°W	0600	98	17	15	02	1	1015.4	3	1.6	74.4	70.8	74.9	6	6	8	5	0	0	23	3	5
1/8	23.6°N	164.1°W	1200	92	19	27	50	1	1016.0	1	0.6	71.0	70.0	74.7	6	6	8	5	0	0	23	3	5
1/8	23.2°N	155.2°W	1800	98	14	15	16	2	1016.9	3	1.6	73.6	70.9	74.1	7	7	4	3	0	0	14	3	3
1/9	22.1°N	165.1°W	0000	98	18	12	01	1	1016.2	8	2.2	77.0	72.0	76.0	3	3	2	3	0	0	15	3	3
1/9	22.6°N	166.9°W	0600	99	16	09	02	0	1017.4	1	1.2	75.5	71.4	76.0	1	1	1	5	0	0	11	3	2
1/9	22.6°N	167.6°W	1200	97	12	18	64	0	1017.5	3	0.0	74.8	71.2	75.9	5	5	3	4	0	0	11	3	3
1/9	22.3°N	168.1°W	1800	99	15	10	02	0	1017.4	3	0.6	75.0	72.0	76.1	3	2	2	5	8	0	13	3	3
1/10	21.7°N	169.1°W	0000	99	19	15	02	1	1016.9	8	2.2	78.0	74.0	77.0	3	2	2	5	6	0	13	3	4
1/10	21.6°N	170.2°W	0600	99	19	07	02	0	1017.5	3	1.0	76.5	72.5	76.9	2	2	2	5	0	0	14	3	4
1/10	21.5°N	170.1°W	1200	98	21	05	01	1	1017.6	6	0.6	77.0	72.5	77.2	1	1	1	5	0	9	14	3	3
1/10	21.1°N	172.1°W	1800	98	27	10	01	5	1018.4	3	1.0	75.1	71.5	77.0	3	3	2	5	0	0	14	3	3
1/11	20.7°N	172.5°W	0000	99	02	20	62	2	1019.2	8	1.6	74.0	70.0	76.2	6	4	6	4	8	0	35	3	5
1/11	20.5°N	173.1°W	0600	97	03	27	02	2	1020.4	3	2.0	74.5	69.5	75.2	6	4	4	5	6	0	32	3	6
1/11	20.2°N	174.4°W	1200	98	05	35	03	2	1022.0	5	0.2	72.5	65.5	75.5	8	4	4	5	9	X	02	3	6
1/11	19.8°N	175.1°W	1800	97	08	32	02	2	1023.4	3	2.0	72.0	64.8	76.6	6	6	4	5	0	0	07	3	8
1/12	20.6°N	175.3°W	0000	97	08	31	01	2	1023.0	8	2.6	74.0	65.0	76.8	2	2	1	5	0	0	05	3	8
1/12	20.6°N	176.3°W	0600	97	07	27	02	2	1023.9	3	1.8	73.5	64.5	76.5	6	6	4	5	0	0	05	3	6
1/12	20.8°N	176.1°W	1200	99	08	18	02	1	1023.4	8	0.6	73.5	65.0	76.8	5	X	X	X	X	X	05	3	6
1/12	20.8°N	177.4°W	1800	99	07	22	02	X	1023.9	X	X	73.5	66.0	76.0	2	X	X	X	X	X	X	X	X
1/13	21.1°N	178.0°W	0000	99	09	22	01	1	1022.0	8	2.2	78.0	68.5	77.2	2	2	1	5	0	0	09	3	4
1/13	21.4°N	178.9°W	0600	99	09	20	02	0	1023.0	3	0.6	75.0	65.5	77.1	1	1	1	4	0	0	09	3	4
1/13	21.8°N	179.8°W	1200	99	08	18	02	0	1022.9	6	1.0	74.5	66.5	77.0	3	3	4	5	0	0	09	3	4
1/13	22.0°N	179.4°E	1800	99	09	20	02	X	1023.0	3	0.6	75.5	67.5	76.5	4	4	4	5	0	0	07	3	3
1/14	22.2°N	178.5°E	0000	99	09	16	03	1	1021.0	8	2.0	77.5	67.5	76.7	7	7	4	5	0	0	08	3	3
1/14	22.5°N	177.6°E	0600	98	09	18	02	2	1019.9	3	0.2	76.0	67.0	76.5	7	7	4	4	0	0	08	3	3

Table 6.--Log of ship's weather observations, Hugh M. Smith cruise 27, January 5 to February 21, 1955. Results in International Ship's Weather Code, January 1955 (cont'd)

Date, 1955	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
1/14	22.7°N	177.2°E	1200	98	07	08	02	2	1020.4	3	0.0	75.5	67.0	76.8	7	7	4	4	0	0	08	3	3
1/14	23.0°N	175.8°E	1800	98	01	10	02	2	1019.9	3	0.6	75.1	67.0	76.0	7	7	4	4	0	0	01	3	3
1/15	23.3°N	174.8°E	0000	99	08	13	01	1	1018.0	8	3.2	75.0	66.5	75.0	1	1	4	5	0	0	11	3	2
1/15	23.6°N	174.0°E	0600	99	02	09	02	0	1017.9	3	1.0	76.5	67.0	76.0	1	1	4	5	0	0	34	3	6
1/15	23.9°N	173.3°E	1200	99	02	19	02	0	1019.9	3	0.6	71.5	67.2	75.0	1	1	4	5	0	0	34	3	6
1/15	24.0°N	172.6°E	1800	94	10	35	50	2	1020.7	5	1.6	70.0	65.8	76.2	8	8	8	5	X	X	10	3	6
1/16	24.2°N	171.9°E	0000	99	03	33	03	6	1023.0	0	0.2	74.0	66.5	76.2	6	6	4	5	6	0	08	3	7
1/16	24.6°N	171.1°E	0600	99	08	31	01	2	1022.5	3	1.0	71.5	63.0	76.3	3	3	4	5	0	0	08	3	7
1/16	24.9°N	170.4°E	1200	99	07	19	02	0	1024.4	0	0.4	71.5	63.0	73.0	3	3	4	5	0	0	08	3	5
1/16	25.2°N	169.5°E	1800	98	09	30	03	1	1023.0	3	0.6	71.5	65.5	72.5	7	7	4	5	0	0	08	3	5
1/17	26.0°N	169.5°E	0000	99	10	18	02	1	1024.9	0	0.0	73.0	63.5	71.8	3	3	4	5	0	0	08	3	5
1/17	26.7°N	169.6°E	0600	99	10	16	02	0	1024.8	3	0.8	69.9	62.5	70.4	0	0	0	X	0	0	08	3	4
1/17	27.5°N	169.8°E	1200	99	12	07	02	0	1025.4	3	0.2	70.0	62.2	70.0	0	0	0	X	0	0	08	3	4
1/17	28.1°N	169.8°E	1800	99	12	05	02	0	1024.0	3	0.6	68.5	61.0	70.5	0	0	0	X	0	0	08	3	2
1/18	28.8°N	169.9°E	0000	99	20	10	02	0	1023.4	6	1.0	72.0	65.1	71.4	1	1	4	5	0	0	08	3	4
1/18	29.5°N	169.6°E	0600	99	25	16	02	1	1021.8	6	0.2	70.0	65.1	70.9	4	1	1	4	3	0	25	3	3
1/18	30.2°N	170.0°E	1200	99	23	16	03	0	1021.4	8	0.6	68.5	66.0	69.5	6	0	0	9	1	0	25	3	4
1/18	31.1°N	170.6°E	1800	99	27	20	02	1	1018.0	6	0.6	66.4	64.9	67.4	4	4	1	X	1	0	25	3	4
1/19	31.8°N	170.7°E	0000	99	28	25	03	0	1017.9	8	1.6	65.1	62.5	64.8	1	1	8	4	0	0	29	3	4
1/19	32.5°N	170.9°E	0600	97	29	20	50	1	1015.0	8	1.0	62.5	62.5	62.5	8	0	0	9	2	0	29	3	4
1/19	32.5°N	171.7°E	1200	99	34	20	01	2	1018.8	3	2.0	60.0	54.9	61.5	2	X	X	X	X	X	29	3	4
1/20	32.6°N	171.4°E	0000	99	34	18	01	1	1024.0	1	1.0	56.5	51.5	61.9	3	3	2	4	0	0	33	3	7
1/20	32.4°N	173.2°E	0600	99	00	11	03	1	1024.7	5	1.0	58.0	53.0	64.0	5	5	8	4	0	0	33	3	5
1/20	32.0°N	172.9°E	1200	99	09	05	02	0	1026.4	3	0.6	58.0	50.0	63.9	2	X	X	X	X	X	30	3	5
1/20	31.9°N	173.5°E	1800	99	19	12	01	1	1025.0	3	1.0	59.0	49.5	63.5	3	1	8	X	6	0	31	3	2
1/21	31.8°N	174.0°E	0000	99	14	15	02	1	1024.9	9	1.0	61.0	53.0	65.8	3	3	4	5	0	0	33	3	4
1/21	31.5°N	174.6°E	0600	99	16	25	02	1	1021.5	8	0.6	62.9	55.6	64.5	7	7	4	5	0	0	17	2	4
1/21	31.6°N	175.2°E	1200	99	19	30	02	1	1020.4	8	1.6	63.5	56.0	63.5	3	X	X	X	X	X	17	2	4
1/21	31.4°N	175.8°E	1800	99	19	33	01	1	1016.6	8	1.6	66.0	61.5	65.5	2	X	X	X	X	X	17	3	4
1/22	31.3°N	176.3°E	0000	97	21	32	02	1	1014.9	8	1.6	68.0	64.0	65.0	6	6	4	4	0	0	18	3	6

Table 6.--Log of ship's weather observations, Hugh M. Smith cruise 27, January 5 to February 21, 1955. Results in International Ship's Weather Code, January 1955 (cont'd)

Date, 1955	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
1/22	31.0°N	176.9°E	0600	96	24	23	63	2	1015.5	3	1.6	66.8	65.1	66.5	8	8	5	3	X	X	19	3	5
1/22	30.8°N	177.4°E	1200	96	25	04	51	2	1018.4	3	1.2	65.0	63.5	66.0	9	9	X	0	X	X	18	3	3
1/22	30.4°N	177.9°E	1800	96	19	20	02	2	1018.4	3	0.2	67.0	65.0	66.0	9	9	X	0	X	X	19	3	3
1/23	30.2°N	178.4°E	0000	99	20	15	01	1	1018.8	0	1.0	68.0	65.1	65.5	6	6	6	4	0	0	24	3	3
1/23	29.9°N	178.9°E	0600	93	21	20	46	1	1017.5	3	0.6	66.0	65.8	66.2	2	2	1	4	0	0	24	3	3
1/23	29.7°N	179.5°E	1200	95	24	23	46	1	1018.9	3	0.0	67.0	66.1	66.0	9	9	X	0	X	X	24	3	3
1/23	29.2°N	179.7°W	1800	99	20	20	01	2	1019.0	5	0.0	68.0	67.0	68.0	7	3	4	4	0	9	24	3	4
1/24	29.1°N	179.1°W	0000	99	24	15	02	0	1018.9	8	0.8	70.1	67.2	67.5	1	1	4	4	0	0	24	3	4
1/24	28.8°N	178.3°W	0600	99	28	16	03	1	1019.4	3	1.0	70.0	64.5	68.0	7	7	4	4	0	0	27	3	4
1/24	28.1°N	178.1°W	1200	99	27	16	02	0	1020.9	9	0.6	69.8	63.0	69.5	1	X	X	X	X	X	27	3	2
1/24	28.2°N	177.6°W	1800	98	33	13	01	-	1020.6	3	0.6	67.5	62.5	67.5	1	1	2	4	0	0	27	3	2
2/1	29.1°N	179.3°W	1800	91	30	10	60	1	1014.7	5	0.6	70.0	67.0	68.0	9	9	X	0	X	X	27	3	1
2/2	29.3°N	179.9°E	0000	98	29	07	51	5	1015.4	8	1.2	64.0	61.0	67.0	9	0	0	9	2	0	36	3	3
2/2	29.7°N	179.4°E	0600	96	22	18	61	6	1013.1	3	0.2	63.5	62.0	65.9	8	8	6	3	X	X	14	3	3
2/2	30.3°N	179.7°E	1200	99	33	11	02	0	1014.9	3	0.0	65.5	60.0	66.1	4	4	4	4	0	0	27	3	4
2/2	31.0°N	180.0°	1800	99	32	10	02	2	1014.3	3	0.0	62.8	55.8	65.5	0	0	0	9	0	0	27	3	4
2/3	32.0°N	179.8°W	0000	99	28	10	03	1	1015.4	9	0.0	65.0	58.1	65.0	5	5	4	4	0	0	30	3	4
2/3	32.6°N	180.0°	0600	98	29	19	03	1	1015.0	3	2.6	61.0	55.5	64.5	7	7	4	4	0	0	29	3	4
2/3	33.0°N	179.9°E	1200	98	33	35	01	2	1015.0	3	0.6	57.8	51.0	63.0	4	4	4	4	0	0	30	3	6
2/3	33.8°N	179.9°E	1800	99	33	30	02	1	1020.0	3	2.0	54.5	50.0	62.0	3	2	1	4	0	1	33	3	6
2/4	34.4°N	179.9°E	0000	98	36	29	02	1	1023.0	3	0.0	54.0	47.0	62.5	5	5	1	3	0	0	34	3	8
2/4	35.0°N	179.8°E	0600	97	03	22	03	1	1027.4	3	2.6	54.0	46.5	56.0	6	6	1	3	0	0	32	3	6
2/4	35.5°N	179.7°E	1200	99	03	24	02	1	1028.4	3	0.8	53.0	45.8	60.0	7	7	4	4	0	0	33	3	6
2/4	36.4°N	179.4°E	1800	97	03	18	03	1	1031.0	3	2.0	55.0	47.5	57.0	7	7	7	4	0	0	33	3	6
2/5	36.8°N	180.0°	0000	99	07	20	02	0	1032.1	0	0.0	51.0	46.0	58.5	3	3	1	5	0	0	36	3	5
2/5	37.0°N	179.0°W	0600	99	07	16	02	0	1032.9	3	1.2	52.1	46.7	58.7	3	3	1	5	0	0	36	3	5
2/5	36.9°N	178.1°W	1200	99	10	14	02	0	1035.7	3	0.7	52.1	46.9	59.0	3	3	1	5	0	0	36	3	5
2/5	37.2°N	177.3°W	1800	99	06	24	02	0	1035.4	1	0.8	51.5	45.8	58.0	2	2	4	4	0	0	05	3	5
2/6	37.1°N	176.2°W	0000	99	10	18	02	0	1036.8	0	0.0	52.8	46.9	57.2	3	3	4	5	0	0	05	3	5
2/6	37.0°N	175.5°W	0600	99	11	16	02	0	1036.5	5	0.0	51.0	46.0	58.2	3	3	1	5	0	8	05	3	2

Table 6.--Log of ship's weather observations, Hugh M. Smith [illegible]
21, 1955. Results in International Ship's Weather Code, January 1955 (cont'd)

Date, 1955	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
2/6	37.0°N	174.8°W	1200	99	14	10	02	0	1037.6	1	0.6	50.5	46.2	55.7	4	2	1	5	0	8	05	3	2
2/6	36.8°N	173.6°W	1800	99	10	21	02	0	1035.8	8	1.3	50.9	45.8	53.5	3	2	1	5	0	8	03	3	2
2/7	36.4°N	173.3°W	0000	99	11	22	02	1	1034.9	8	1.0	52.1	46.7	55.0	7	7	4	4	0	0	09	3	3
2/7	35.4°N	173.5°W	0600	99	11	22	02	1	1033.4	6	0.6	52.0	48.0	56.0	7	0	0	9	2	0	09	3	5
2/7	34.8°N	173.5°W	1200	99	13	23	02	1	1031.0	6	0.6	54.8	49.4	57.3	8	0	0	9	2	X	07	3	5
2/7	34.1°N	173.2°W	1800	98	18	19	02	2	1029.4	2	0.0	57.0	52.0	58.0	8	0	0	9	2	X	11	3	3
2/8	33.5°N	173.1°W	0000	98	15	22	03	2	1027.4	8	2.6	60.0	53.5	59.0	8	0	0	9	2	X	13	3	4
2/8	32.6°N	173.1°W	0600	97	18	16	02	2	1027.4	3	2.2	62.0	54.5	61.0	7	X	X	X	X	X	13	3	3
2/8	32.1°N	173.1°W	1200	99	17	17	01	2	1026.1	6	1.3	62.0	57.0	60.9	7	7	8	5	0	0	16	3	3
2/9	30.5°N	172.9°W	0000	99	14	04	01	1	1027.0	9	2.0	64.0	57.0	62.0	1	1	1	4	0	0	12	3	2
2/9	29.7°N	173.0°W	0600	99	14	10	02	0	1025.4	3	0.6	62.5	57.5	62.9	1	1	1	4	0	0	11	3	3
2/9	29.2°N	172.7°W	1200	99	08	10	03	0	1026.3	0	0.6	63.9	57.5	67.8	6	6	1	4	0	0	11	3	3
2/9	28.3°N	172.7°W	1700	99	08	16	02	1	1026.0	6	1.3	64.0	57.5	67.5	7	7	8	4	0	0	07	3	4
2/10	27.6°N	172.4°W	0000	99	08	16	01	2	1025.4	8	1.0	68.0	59.0	70.0	5	5	4	4	0	0	09	3	4
2/10	26.7°N	172.0°W	0600	98	08	21	03	2	1024.9	3	0.6	62.9	60.9	70.5	6	X	X	X	X	X	11	3	4
2/11	26.2°N	171.0°W	1200	99	04	17	01	1	1024.9	3	0.0	67.5	60.4	69.0	2	2	2	5	0	0	07	3	4
2/11	26.8°N	170.6°W	1800	99	05	20	03	1	1025.9	3	1.0	64.5	62.0	69.0	6	6	2	5	0	0	07	3	4
2/12	27.3°N	169.9°W	0000	98	06	21	02	2	1025.9	6	1.0	67.2	60.0	67.7	7	7	8	5	0	0	05	3	4
2/12	27.8°N	169.2°W	0600	99	05	28	02	2	1027.1	3	1.4	66.2	58.9	67.3	7	7	8	5	0	0	05	3	5
2/12	28.0°N	168.7°W	1200	99	05	20	01	1	1028.4	8	0.8	65.0	57.5	67.0	4	4	1	4	0	0	05	3	5
2/13	29.0°N	167.2°W	0000	99	08	20	02	0	1029.4	8	1.2	65.8	58.0	68.0	2	2	1	4	0	0	08	3	5
2/13	29.5°N	166.7°W	0600	99	08	20	02	0	1030.5	3	2.0	64.0	58.5	66.8	2	2	1	4	0	0	08	3	4
2/13	30.0°N	166.7°W	1200	99	04	18	02	0	1031.0	3	0.6	61.8	57.8	66.9	2	2	1	4	0	0	05	3	4
2/13	30.9°N	166.8°W	1800	99	09	08	02	0	1031.4	3	1.2	59.0	54.9	66.0	3	3	1	4	0	0	07	3	3
2/14	31.6°N	166.8°W	0000	99	09	08	01	1	1030.7	9	2.0	63.0	57.0	62.3	2	2	1	4	0	0	09	3	3
2/14	32.0°N	166.7°W	0600	99	09	08	03	0	1030.7	3	1.2	58.8	54.6	60.2	6	3	1	4	6	0	09	3	3
2/14	32.7°N	166.7°W	1200	99	14	08	02	1	1030.6	8	0.8	60.6	55.5	60.0	6	3	1	4	6	0	16	3	3
2/14	34.1°N	166.6°W	1800	99	12	05	02	1	1029.1	6	0.6	62.0	57.0	58.2	8	0	0	9	6	X	16	3	3
2/15	34.8°N	166.6°W	0000	99	14	02	03	2	1027.1	8	2.0	59.0	57.0	56.5	7	7	4	4	0	0	16	3	2
2/15	35.5°N	166.7°W	0600	99	18	10	02	2	1025.5	3	0.0	57.5	55.3	55.1	7	0	0	9	6	0	16	3	2

Table 6.--Log of ship's weather observations, *Hugh M. Smith* cruise 27, January 5 to February 21, 1955. Results in International Ship's Weather Code, January 1955 (cont'd)

					Wind		Weather		Pressure			Temperature			Clouds						Waves		
Date, 1955	Latitude	Longitude	Time, GCT	Visibility	Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
2/15	36.1°N	166.7°W	1200	98	21	15	02	2	1021.6	8	2.0	56.8	55.2	55.1	8	X	X	X	X	X	18	3	3
2/15	37.0°N	166.7°W	1800	97	21	30	62	2	1017.0	8	2.0	57.0	56.0	54.9	8	0	0	9	2	X	21	3	4
2/16	37.0°N	166.0°W	0000	95	27	15	50	5	1016.4	6	0.6	56.0	55.0	54.2	9	9	X	0	X	X	23	3	5
2/16	37.0°N	164.2°W	0600	99	30	15	01	5	1017.3	3	1.3	53.8	51.4	54.0	7	7	5	3	0	0	27	3	4
2/16	37.2°N	163.7°W	1200	99	30	10	02	1	1019.1	1	0.6	53.5	49.5	53.1	6	6	5	3	0	0	27	3	3
2/16	37.0°N	162.4°W	1800	99	30	17	02	0	1018.9	3	2.0	53.0	49.5	52.1	4	4	8	4	0	0	29	3	4
2/17	37.0°N	161.4°W	0000	99	33	17	01	2	1021.6	0	1.2	50.2	46.2	54.0	3	3	2	4	2	0	30	3	4
2/17	37.0°N	160.2°W	0600	99	32	20	02	1	1023.5	5	1.0	49.4	43.5	55.0	3	3	2	4	2	0	30	3	4
2/17	36.5°N	160.0°W	1200	99	27	10	02	1	1024.1	2	0.0	49.8	44.2	54.8	2	2	2	4	0	0	32	3	4
2/17	35.6°N	159.9°W	1800	99	04	06	02	0	1026.9	3	1.8	51.0	45.0	55.0	3	0	0	9	0	6	04	3	3
2/18	34.7°N	159.8°W	0000	99	12	06	01	0	1026.4	9	1.2	53.0	46.5	57.0	1	1	0	3	1	0	30	3	4
2/18	34.0°N	159.7°W	0600	99	14	08	02	0	1026.5	3	1.0	53.8	49.0	57.0	1	0	0	9	8	5	30	3	5
2/18	33.1°N	159.7°W	1200	99	13	15	02	0	1026.7	3	0.6	55.4	51.0	60.0	0	0	0	9	0	0	30	3	3
2/18	32.4°N	159.5°W	1800	99	12	06	03	0	1027.4	3	0.0	58.8	53.0	60.0	2	0	0	9	9	2	30	3	3
2/19	31.4°N	159.4°W	0000	99	14	15	02	0	1024.9	8	2.0	61.5	55.5	63.5	2	0	0	9	9	1	13	3	3
2/19	31.0°N	159.3°W	0600	99	07	10	02	0	1027.0	3	2.0	62.2	58.8	63.9	3	0	0	9	1	1	14	3	2
2/19	29.9°N	159.3°W	1100	99	09	10	02	0	1026.5	8	1.0	64.5	58.2	66.0	2	0	0	9	0	1	11	3	2
2/19	29.1°N	159.2°W	1800	99	12	10	03	2	1025.6	3	0.6	66.0	60.5	66.5	6	2	1	4	2	0	12	3	2
2/20	28.2°N	159.1°W	0000	99	12	20	01	1	1022.4	8	2.4	69.0	64.0	70.0	4	4	2	5	0	0	12	3	4
2/20	27.5°N	158.9°W	0600	99	08	20	03	1	1022.5	3	0.7	68.0	63.0	69.2	6	6	2	5	0	0	08	3	4
2/20	26.6°N	158.8°W	1300	99	07	20	02	1	1018.4	6	1.0	69.0	63.0	70.0	X	X	X	X	X	X	08	3	4
2/20	26.1°N	158.8°W	1800	98	07	20	50	2	1028.0	3	1.0	67.5	65.0	70.5	7	7	2	4	0	0	08	3	4
2/21	25.1°N	158.7°W	0000	92	07	20	63	2	1014.4	8	1.6	69.5	67.5	71.5	9	9	X	0	X	X	08	3	5
2/21	24.5°N	158.5°W	0700	98	06	05	01	1	1012.2	3	0.7	70.5	67.8	71.0	6	6	8	4	0	0	06	3	5
2/21	23.9°N	158.5°W	1100	99	09	10	02	1	1010.9	8	0.4	71.0	68.0	72.0	2	2	8	4	0	0	06	3	3
2/21	23.1°N	158.4°W	1800	99	20	05	16	1	1010.0	1	1.0	69.0	68.0	72.0	4	4	8	4	6	0	08	3	3

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NOTES

An Unusually Large Salp

A large example of *Thetys vagina* Tilesius, itary form, was captured in a 1-meter (mouth meter) closing-type plankton net at a depth tween 120 and 170 meters by the Pacific eanic Fishery Investigations, U. S. Fish and ildlife Service, on February 5, 1956, at 22° 'N. latitude, 157°46'W. longitude. The speci- en measured 306 mm. in length without proc- sses and 333 mm. with processes. By water splacement its total volume equalled 278 ml. This specimen is apparently larger than any lp previously known and is therefore con- dered worthy of note. The largest salps pre- ously reported have had lengths as follows: *hetys vagina*, solitary form, 226 mm. (Trau- edt, 1885. *K. Danske Vidensk. Selsk., Skr., aturv. og. Math. Afd.* 2(8): 337–400 [as *Salpa tata-tilesii*]); *Helicosalpa komaii* (Ihle and Ihle-Landenberg), solitary form, 230 mm. (Komai, 1932. *Kyoto Univ., Col. Sci., Mem.*, Ser. B. 8(1): 65 80 [as *Salpa virgula*]); *Salpa maxima* Forskål, solitary form, 230 mm. (Thompson, 1948. *Pelagic Tunicates of Australia.* Commenwealth Council for Scientific and Industrial Research, Melbourne. 196 pp.). In volume the largest specimen previously reported was a solitary form of *Helicosalpa virgula* (Vogt), 141 mm. in length, which measured 158 ml. in total volume by water displacement (Yount, 1954. *Pacific Sci.* 8(3): 276–330).

The nomenclature used in this note follows that of Yount (*ibid.*).—*Eugene L. Nakamura, Pacific Oceanic Fishery Investigations, U. S. Fish and Wildlife Service, Honolulu, Hawaii, and James L. Yount, Dept. of Biology, University of Florida, Gainesville, Florida.*

MEAT PIGMENT STUDIES

ctral Reflectance Studies of the e Pigments in Tuna Fish Flesh. e Characteristics of the Pigments Discoloration of Tuna Meat

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During investigations on the "greening" in certain yellowfin tuna on precooking, information regarding the characteristics and reactions of the heme pigments in tuna meat was revealed, largely through application of the technique of spectral reflectance. Spectral evidence indicated a predominance of hemoglobin rather than myoglobin in the flesh pigments, an increase in methemoglobin and denaturation on storage, and a greater solubility of methemoglobin in aqueous media in contrast to oxyhemoglobin. Greening is an actual color condition due to an anomalous heme protein oxidation. Related are high concentrations of methemoglobin, some denaturation, and a slightly high fat peroxide content in the raw meat. Oxygen starvation due to the exhaustion of the fish during landing does not appear to produce factors that lead to greening, but changes that occur even in the frozen state seem to be responsible.

ISCOLORATION of meatstuffs is a lem familiar to the packers and of such products. Present e of the cause and probable ns producing a variety of such s has been summarized by). One similar off-color varia- nized in fish meat is the unde- reen" color that develops in the rtain tuna on precooking, prior g, and results in considerable loss to the fisherman and to the *19*).

oblem has been the subject of research by the Japanese (*16*). a and Takahashi (*15*) have a correlation between the of tuna and the concentration pigment identified spectro- cally by them as myoglobin. ently Brown, Tappel, and Olcott (*5*) have reported on work which indicates that the pigment responsible for greening is a hemichrome.

The advantages of spectral reflectance applied to biochemical problems have been pointed out (*4, 18*). Application of this method to the present investigation was obvious, because it made possible the study of the normal or anomalous protein pigments in raw and cooked flesh, and of the changes induced by the variation of experimental conditions.

Materials and Methods

Samples used in this research were carefully trimmed sections of the loins of yellowfish tuna (70 to 200 pounds), *Neothunnus macropterus* (Temminck and Schlegel), caught on long line by research vessels of the Pacific Oceanic Fishery Investigations of the U. S. Fish and Wildlife Service in the central equatorial Pacific. The fish were frozen on board, as soon as possible after capture. Yellowfin up to 15 pounds were caught by trolling in local waters and sampled while fresh.

To obtain precooked samples for the evaluation of color, frozen fish were thawed in tanks at Hawaiian Tuna Packers, Ltd., and cut into loins. One loin from each fish was retained as a raw sample. The remaining loins were put through the regular commercial precooking process of that company. Color grade of the precooked samples was judged by the company's food technologist. Specific samples characteristic of their types (normal, green, pink, etc.) as subjectively judged, were used in much of the work.

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Reflectance spectra in the visible range (400 to 700 mμ) were obtained with a Beckman DU spectrophotometer equipped with a standard reflectance attachment. All chemicals used were reagent grade.

The meat was forced through a 16-mesh stainless steel screen and packed it into a $1^1/_4 \times {}^1/_{16}$ inch aluminum planchet. Chemical treatment was accomplished by adding the reagents to the meat in the planchet. A glass plate was then pressed firmly upon the meat until a uniformly smooth surface was produced, to obtain a diffuse surface and eliminate gloss or directional color. Immediately after preparation the planchet was introduced into the reflectance attachment of the spectrophotometer, and relative reflectance was measured by comparison with a pure high-fired alumina disk, likewise covered with a glass plate. Apart from oxidative variations, well ground and thoroughly homogenized samples gave readings that were reproducible to ±0.5% reflectance unit. Replicate, nonhomogenized samples from the same fish loin gave an average precision of ±1.5% reflectance unit. Absorbance (optical density) was used in the curve plots, because Beer's law was obeyed in the systems studied.

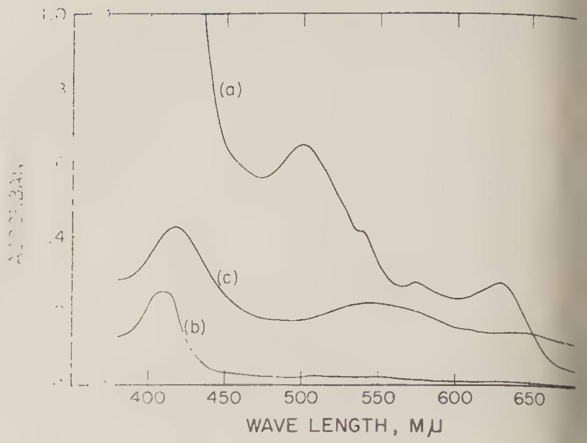

Figure 1. Separation of aqueous extract of raw tuna into methemoglobin and metmyoglobin by phosphate fractionation

a. Transmission curve for original extract
b. Transmission curve for residual solution after methemoglobin precipitation with phosphate
c. Reflectance curve of phosphate precipitated material

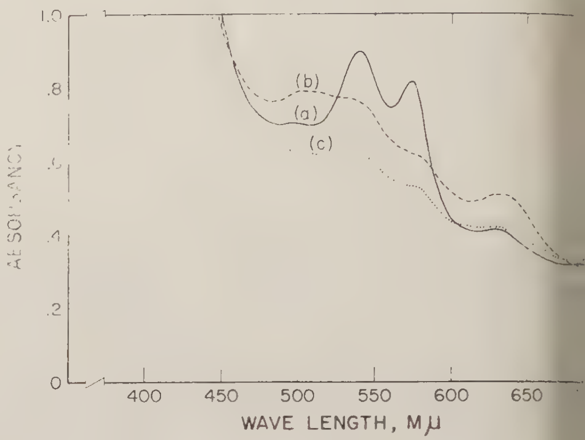

Figure 2. Reflectance curves showing pigment mixture found in raw tuna flesh

a. Largely oxyhemoglobin
b. Largely methemoglobin
c. Mixture of met- and oxyhemoglobin

SOME CHARACTERISTICS OF THE PIGMENTS

Nature of Pigments in Raw Tuna Meat A natural assumption is that myoglobin, or muscle hemoglobin, is a major pigment imparting color to the tuna flesh. Certain experiments have cast doubt on the validity of this assumption. Bowen (*2*) and others have found that absorption peaks for mammalian myoglobin are displaced to longer wave lengths in the case of certain derivatives of the pigment. The peaks for the corresponding derivatives of tuna pigments were carefully measured and no such shift was observed. Instead, the curves obtained were identical with those characteristic of hemoglobin and its derivatives. To substantiate these results, the solubility of the extracted pigments in buffered phosphate was checked according to the procedure of Morgan (*17*) as modified by Ginger, Wilson, and Schweigert (*10*). The separation of the myoglobin from the hemoglobin by this method is based upon the solubility of the former and the insolubility of the latter compound in the phosphate buffer. The myoglobin was estimated as metmyoglobin through transmission measurements and the hemoglobin as methemoglobin by the examination of the residue through spectral reflectance.

Assuming that these procedures separate myoglobin from hemoglobin on the basis of their solubility in the differentiating medium, it was found that the pigments in tuna flesh were about 95% hemoglobin, with myoglobin comprising a minor fraction of the pigment system (Figure 1). Matsuura and Hashimoto (*14*) report all pigment in ordinary muscle of yellowfin tuna as hemoglobin (140 mg.%). The experiments described have not been sufficiently exhaustive to warrant a definite conclusion regarding this point. The main muscle pigment in tuna meat, if not hemoglobin, may be different from the corresponding pigment in mammalian flesh (*20*). Thus, the actual nature of the pigment in tuna meat is not yet definitely established. The distribution of the pigments, however, between myoglobin and hemoglobin is not pertinent to the color changes in tuna meat, because these involve the porphyrin moiety which is identical for both. The pigments in tuna flesh are referred to hereafter as hemoglobin or its derivatives.

Examination of the raw tuna meat by means of spectral reflectance seemed to indicate that oxy- and methemoglobin were the principal heme pigments present. Some typical curves characteristic of the oxy- and methemoglobin mixtures encountered are shown in Figure 2.

Pigment Changes in Raw Flesh **Conversion of Oxyhemoglobin.** Fairly rapid oxidative deterioration was observed in tuna meat even when stored in a freezer. The concomitant conversion of oxyhemoglobin with time was observed by following the change in the reflectance spectra periodically (Figure 3). Complet
version to methemoglobin was
plished quickly by oxidation with
sium ferricyanide (Figure 3,*B*,*e*).
the changes correspond to a d
in oxyhemoglobin can be verif
comparison of these data, prese
simplified curves, with similar
in absorption obtained by Aust
Drabkin (*1*) for oxy- and m
globin mixtures of known comp
(Figure 3,*A*).

Examination of these results in
that the pigment systems in tun
were extremely susceptible to e
mental changes. The major char
takes place at freezer temperatu
conversion of oxyhemoglobin to
moglobin which is not desirable,
it is accompanied by a certain deg
discoloration. This, in turn, mig
crease the value of the meat fro
commercial standpoint.

Deoxygenation of Oxyhemog
An attempt at reducing oxyhemo
to hemoglobin by exposing the
meat to evacuation and a
nitrogen purge, a procedure whic
mally removes the oxygen of th
compound, resulted in a rapid con
of oxyhemoglobin to methemo
Typical reflectance spectra showi
change are presented in Figure
results may be an example
phenomenon noted by Brooks (
found that the conversion of o
globin to methemoglobin proceed

t low partial pressures of oxy-
a maximum at 20 mm.

nt Denaturation. Examina-
ne spectral reflectance curves of
meat reveals that some degree
uration of the protein moiety of
pigment molecule takes place
low temperatures. Such dena-
produces denatured globin hemi-
(*12*) more easily identified in the
condition as the denatured glo-
ochromes, because their absorp-
es exhibit pronounced peaks at
558 mμ. Figure 5 shows repre-
spectral curves obtained with
t. Fresh tuna meat, chemically
with dithionite, gives the charac-
osorption peak of hemoglobin at
Figure 5, *a*). When subjected to
aturation by heating to 50° C.
nutes the same reduced meat ex-
distinct hemochrome peak at 528
ure 5,*b*). Similar denaturation
observed in curve *c* for a reduced
ole which is rich in methemoglo-
n curve *d* for a second sample of
type of meat commercially pre-
nd reduced. It is remarkable
ooking, as in the last instance,
appear to have increased the de-
n of the pigment markedly as
y the hemochrome peak at 528
ere is some indication from a
of such raw, reduced samples
degree of denaturation in tuna
irectly related to the amount of
globin originally present.

lity of Methemoglobin. The
edly greater solubility of met-
bin in aqueous media when
d to oxyhemoglobin in tuna
n example of unusual pigment
nd behavior encountered in this
Aqueous extracts of tuna flesh
orption curves characteristic of
globin. Examination of the re-
pectra of tuna meat obtained
nd after subjecting samples to
action showed that methemo-
characterized by a rather great
in water, whereas oxyhemoglo-
its a high degree of insolubility.
case demonstrating this differ-
own in Figure 6. This suggests
ment leaching during thawing
ooking might be a factor in pro-
washed-out condition in tuna
her meats with a high methemo-
ntent. It might also be applied
ns of lightening meat color, and
ng flesh pigments that might be
ed during precooking.

s
d
eat

Cooking of tuna meat
results in the denatura-
tion and coagulation of
the proteins present with
ant lightening of the meat
enaturation of the heme pro-
s to the formation of the hemo-
f the denatured globin. Char-
absorption, aside from the So-
n, occurs at 545 and 575 mμ (Figure 7, curves *a* and *b*), in agreement with the values listed for the denatured hemochrome of hemoglobin (*12*). Because the absorption of this substance is weak and poorly defined, the more easily characterized curve of the reduced, or ferrous, denatured globin hemochrome previously mentioned was used for identification purposes. The contrast is evident in the examples given in Figure 7. The color of the reduced hemochrome is the normal pink which is considered commercially desirable.

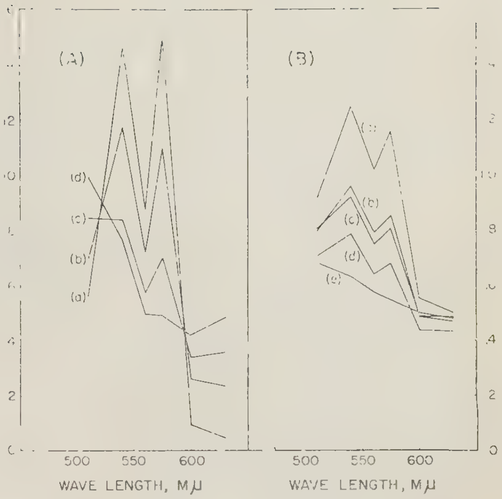

Figure 3. Absorption curves

A. Simplified curve shows decreasing concentration of oxyhemoglobin, in mixture with methemoglobin decreasing from *a* to *d* (*1*)
B. Similar simplified curve taken in reflection for tuna meat after various periods of freezer storage, showing decreasing oxyhemoglobin content

a. Fresh tuna meat
b. After 24 hours of freezer storage
c. After 36 hours of freezer storage
d. After 84 hours of freezer storage
e. After complete conversion to methemoglobin by oxidation with potassium ferricyanide

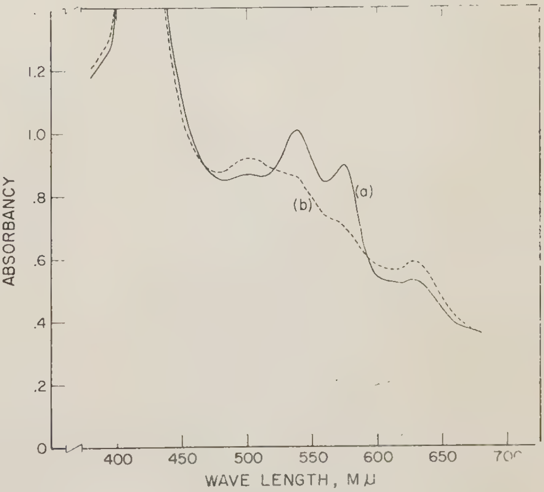

Figure 4. Oxidation of flesh pigment on treatment with nitrogen

a. Reflectance curve of fresh tuna meat
b. Reflectance curve after alternating evacuation and treatment with nitrogen for 3 hours

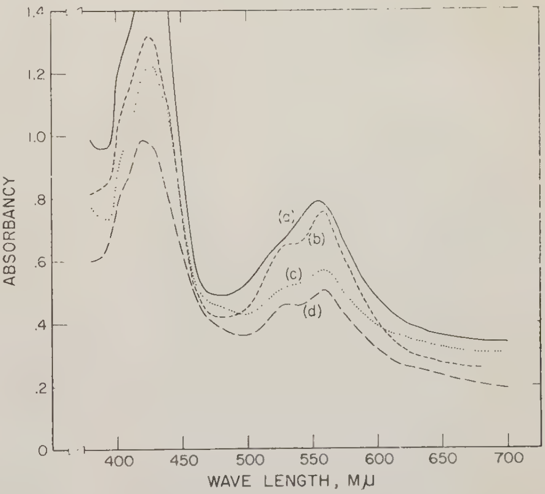

Figure 5. Reflectance curves showing denaturation by appearance of hemochrome band at 528 mμ after reduction with dithionite

a. Reduced raw fresh tuna hemoglobin
b. Tuna flesh of curve *a* after denaturation by heating 20 minutes at 50° C.
c. Reduced raw methemoglobin rich sample
d. Methemoglobin rich sample, commercially precooked, and reduced

DISCOLORATION OF TUNA MEAT

Color of Precooked Tuna Meat. Visual examination of different samples of cooked tuna meat reveals the complexity of the color system involved. Variations from highly bleached to abnormally red meat have been encountered which demonstrate the fluctuations of the absolute content of pigment in the flesh of different fish. It has not been determined whether these variations are physiological or post-mortem in nature. A brown condition is recognized which appears to be a true post-mortem or postcooking phenomenon, due to oxidation of the natural hemochrome on exposure to atmospheric oxygen (*4*). The greening phenomenon, the main object of this research, and an orange coloration are also frequently observed. Both discolorations permeate the fish flesh rather than being associated with exposed surfaces as in the brown condition. The distribution of pigment within a single fish loin, seemingly uniform to the eye, was variable. This was confirmed by a superficial microscopic examination which showed the pigment to be present in bands within the metal. Spectral reflectance measurements gave variable estimates of the amount of pigment present. Uniformity could be assured only by grinding and thoroughly mixing all the meat required in a given sample sequence. This was not usually done because finely ground meat changed color even when held in a frozen condition.

A method used to evaluate greenness objectively was to compare absorption in the red and green parts of the spectrum (640 and 540 mμ, respectively) for cooked, green, and normal meat by reflectance. A green sample would be expected to show greater absorption of light in the red end of the spectrum than in the green, when compared with normal meat. The ratio of the absorbancies at the 540/640-mμ absorption peaks should be greatest for normal and least for green meat. Absorbancy ratios have been used by other investigators (*6*) in evaluating, objectively, the color of cured meats.

It became evident that pigment content was a factor affecting the degree or type of alteration that might occur. Upon the assumption that the height of the most characteristic absorption peak for heme pigments (the Soret peak, at about 415 mμ) can be used as an indication of the absolute pigment content of the cooked meat, several significant relationships were observed by plotting this peak against the above indicated greenness index (540/640 absorption peak ratio) (Figure 8). Normal samples, in general, occupy the portion of the figure indicative of higher 540/640 peak ratio as would be expected, and lower pigment content. It is noteworthy that both the albacore white color resulting from low pigment content and the fleshy pink color associated with a high 540/640 peak ratio are accepted as normal by observers, thus emphasizing the complexity of the systems encompassed by the term normal. The overlapping position of some of the points is due, at least in part, to the uncertainty and ambiguity inherent in the subjective evaluation of precooked flesh.

Green Pigmentation in Precooked Tuna Flesh. It was impractical to extract and identify the green component in precooked green flesh by the use of simple solvent systems. Attempts were made to cleave the pyrrole ring segment from the protein moiety of the pigment molecule by alcohol– or acetone–hydrochloric acid treatment, and to examine the extract by spectral transmission, and the residue by spectral reflection. Green pigmentation in meat has been attributed to an oxidative attack on the pyrrole ring of the heme pigments producing choleglobin or verdohemochrome (*24*). Removal of the oxidized or disrupted ring by the acid-alcohol or acetone treatment, and spectral examination should reveal the nature of the parent pigment. Verdohemochrome, and its postulated precursor choleglobin, for example, would produce biliverdin-like compounds (*12*).

The acid alcohol extracts gave an absorption curve in transmission which showed no characteristic absorption peaks and was very similar to that obtained from the aqueous residue left on

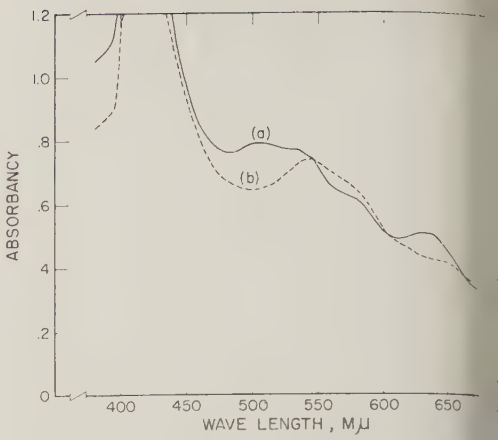

Figure 6. Reflectance curves showing solubility of methemoglobin and insolubility of oxyhemoglobin in raw tuna flesh

a. Raw tuna flesh
b. Residual flesh after aqueous extraction at pH 6.8. Note disappearance of 500 and 630 mμ methemoglobin absorption peaks

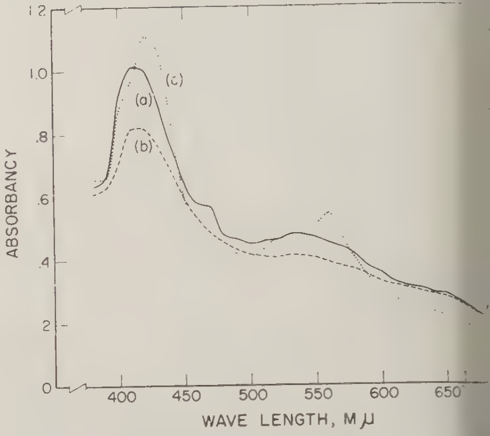

Figure 7. Reflectance curves showing pigments of cooked tuna flesh

a, b. Denatured globin hemochrome of cooked tuna flesh
c. Denatured globin hemochrome of reduced, cooked tuna flesh

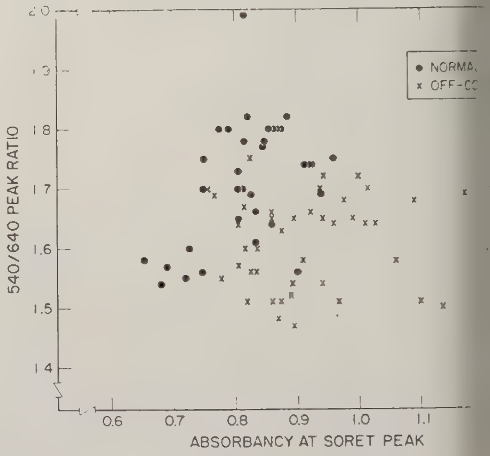

Figure 8. Variation of 540/640-mμ peak ratio with absorbancy at Soret peak (410–415 mμ) an index of pigment content

cooking the fish (Figure 9, *b*).
tion of this material with chlo
however, gave in the extract an
tion curve with transmission peaks
510, 540, and 640 mμ (Figure 9,
and *c*). These absorption maxim
compared in Table I with the pe
ported for some of the products of
protein disruption.

The coincidence of the abso
peaks with those reported by Lew
for hemin chloride in acetone with
hydrochloric acid added is strikin
indicates that this substance may b
ent in the extract. Microscopic
ination of the evaporated residue o
extracts failed to reveal the charac
hemin chloride platelets. No e
of oxidative disruption of the pyrro
was obtained in the soluble fracti
acid-acetone or acid-alcohol treat

esidues left after treatment of the
th acid-acetone and acid-meth-
re examined by spectral reflect-
The main characteristics of the
obtained were very similar to
ported for acid hematin and acid-
emin (*13*).

terest was the slight, but definite
on peak in the red end of the
n at 625 mμ for acid-acetone–
meat (Figure 10, *a*, *b*, and *c*).
ves show a decrease in this peak
om very green meat (curve *a*) to
n (curve *b*) to normal (curve *c*),
he absorption peak has disap-
This peak is a more direct point
nce for the green pigment, the
of which had previously been
more or less indirectly. A simi-
ent, absorbing between 610 and
has been reported by Ginger,
nd Schweigert (*9*) in both trans-
measurements on green-colored
and spectral reflectance curves
l from discolored beef that had
posed to gamma radiation from a
0 source. The pigment noted
resent in a very much lower con-
n and in an insoluble coagu-
m, rendering it difficult to detect
resence of other pigments, and
le to extract into a solvent.

ment present in beef, which may
ar, has been identified as being
ulfmyoglobin (*8*).

**onship between Pigments of
d Precooked Tuna Flesh.** The
tion of many spectral reflectance
r the flesh of raw tuna revealed
ency for flesh with a high content
emoglobin, characterized by a
nt 630-mμ absorption peak, to
n off-color on precooking. The
s complicated by the presence of
globin, which seems to modify
t of methemoglobin and, when
n high concentration, produces
at that browns rapidly on expo-
ir. Frequently a high concen-
f both oxyhemoglobin and met-
bin is found. The possible com-
result in a gamut of gray to
orange pigmentation on pre-
depending on the relative
of each parent pigment.

aluation of the relationship of
jectively and objectively judged
methemoglobin content is shown
s 11 and 12. The height of the
n peak in the red region at 630
acteristic of methemoglobin, was
an indication of the amount of
ent in the raw meat and was
l by means of the ratio of
mμ absorption. Off-color of
meat on precooking was judged
ely by the food technologist of
Tuna Packers on a scale which
. plus one (excellent), zero
and minus value (for increas-
es of greenness and off-color)
1). There seems to be a definite relationship between these factors.

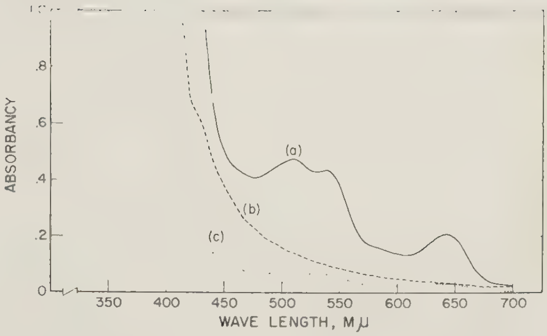

Figure 9. Spectral absorbance measured in transmission of extracts of precooked green tuna flesh

a. Chloroform extract of hydrochloric acid–acetone extract
b. Original hydrochloric acid–methanol extract
c. Chloroform extract of *b*

Table I. Characteristic Absorption Peaks of Heme Pigment Derivatives

Pigment	Absorption Maxima, Mμ I	II	III	IV
Muscle pigment in chloroform	640	540	510	382
Hemin chloride and hydrochloric acid (*13*)	640	540	512	382
Green skeletal pigment of skipjack in chloroform (*7*)	660	. .	. .	380
Methanolic ester of biliverdin in chloroform (*23*)	685	. .	. .	380
Biliverdin hydrochloride in hydrochloric acid–methanol (*12*)	680	. .	. .	377
Protoporphyrin in ether–acetic acid (*12*)	632.5	537	502	395
Coproporphyrin in chloroform (*11*)	622.5	533	499	405

Objective evaluation of greenness in precooked meat was made through the use of the absorption ratio at 540/640 mμ. The comparison of this color rating with the methemoglobin content is shown in Figure 12. An interrelationship is indicated, complicated by the orange color abnormality that is frequently encountered. It is surprising that this also seems to be related to a high methemoglobin content. The large number of coexisting flesh pigment forms and colors (pink, orange, green, and brown) gives a complicated system in which correlating factors are readily obscured. Nonetheless, the evidence seems to point rather definitely to methemoglobin as a dominating factor in the discoloration of tuna flesh.

Relationship of Fat Peroxides to Discoloration. The suspicion of oxidation, as one factor related to greening, has led to speculation on the role of fat peroxides in this phenomenon. The coupled oxidation of hemoglobin and unsaturated fats in mammalian meat tissue has been the subject of much research (*24*). The oxidation of unsaturated fats to peroxides is accelerated by heme compounds and is accompanied by the oxidation of the heme. The resulting fat peroxide may, in turn, play a role in furthering the deterioration of heme pigments. Hydrogen peroxide forms unstable addition compounds with hemoglobin, which subsequently decompose with destruction of the heme moiety of the molecule (*11*). A greening of tuna meat has been observed on treatment with dilute solutions of hydrogen peroxide.

To test the possibility of a correlation between peroxide formation and oxidation of the heme pigment, the fat content of tuna flesh has been determined by a modification of the cold extraction method of Sperry (*22*), carried out in deaerated solutions under a blanket of nitrogen. The peroxide content was determined by titration of iodine with standard thiosulfate solution (Table II). The iodine was released from an iodide solution by the peroxide present in the extracted fat. Appropriate blank determinations were made.

For the samples run, there is an indication of a high peroxide content in green and off-color flesh, which is in agreement with the postulated oxidation of fats along with the oxidation causing greening. The increased peroxide is most pronounced for abnormally pink or orange samples, and less so for green.

The investigation of the fat content and the peroxide values, related as they seem to be to the oxidation of heme compounds, is particularly pertinent, because it is known that fish derive their fat mainly, if not entirely, from dietary fat. The fat is deposited in the tissues more or less unchanged (*21*). The highly speculative conjecture could be made that the differences among fish of the same species, which result in greenness being exhibited by certain specimens, are related to differences in dietary fat intake. The presence of fats susceptible to oxidation—i.e., linoleic and linolenic acid fats—would in turn render the heme pigments present subject to easy oxidation.

Fish Exhaustion and Methemoglobin Content. As a result of the accelerated conversion of oxyhemoglobin to methemoglobin in the absence of oxygen (nitrogen and evacuation), anoxia, or lack of oxygen, in the muscle of the fish brought on by exhaustion might lead to a high methemoglobin content with consequent increased incidence of greening. Such a condition is probable for certain

STRIBUTION, ABUNDANCE, AND HABITS OF PELAGIC SHARKS IN THE CENTRAL PACIFIC OCEAN

BY DONALD W. STRASBURG

FISHERY BULLETIN 138
From Fishery Bulletin of the Fish and Wildlife Service
VOLUME 58

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

NITED STATES DEPARTMENT OF THE INTERIOR, Fred A. Seaton, *Secretary*
FISH AND WILDLIFE SERVICE, Arnie J. Suomela, *Commissioner*

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March 3, 1849

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ABSTRACT

The distribution and abundance of the central Pacific pelagic sharks was investigated by longline fishing methods during 1952–55. In this period more than 6,000 sharks were caught; these belonged to 12 species. Great blue, whitetip, and silky sharks predominated. Bonito, thresher, mackerel, and other species were uncommon or rare.

Several significant facets of the biology of the common sharks were evident. The wide-ranging great blue shark made pronounced seasonal migrations during which sexual segregation occurred and reproduction probably took place. Vertical distribution of the great blue shark was limited in the north by the 45°–69° F. isotherms, and it was truly an oceanic species. The whitetip and silky sharks were denizens of the Tropics, and showed no particular migratory tendencies; the former was oceanic but the latter tended to be neritic.

In equatorial waters, great blues and whitetips were more abundant in warm years, and the silky more abundant in cold years. The species considered here fed principally on small fish and squid. The great blue shark was virtually harmless to the tuna catch. Only 1 percent of the catch was damaged where it abounded, as compared with 20 percent damaged in regions where the whitetip and silky sharks were dominant. In the great blue shark both the behavioral and geographical types of sexual segregation were found, and sexual segregation itself was related to latitude, shark length, and season.

ISTRIBUTION, ABUNDANCE, AND HABITS OF PELAGIC SHARKS IN THE CENTRAL PACIFIC OCEAN

By Donald W. Strasburg, *Fishery Research Biologist*, BUREAU OF COMMERCIAL FISHERIES

Pacific Oceanic Fishery Investigations) of the United States Fish and Wildlife is authorized to investigate the high seas resources of the tropical and subtropical Ocean. A large part of POFI's research n has dealt with the biology of tunas, the of which have been sampled extensively by e fishing. In addition to tuna, spearfish, ner species of commercial importance, an tal product of longlining has been the cap- numerous pelagic sharks. Information on urrence of these sharks is of importance to e biologist and the commercial fisherman of the sharks' competitive and predatory to tuna and also because of the damage inflict on hooked tuna. Apart from dis- in systematic and general works (Bigelow hroeder, 1948, Englehardt 1913, Norman nd Norman and Fraser, 1949) and the fragmentary data in faunal reports, little n of the biology of high seas sharks, and ormation on their abundance, distribution, its is of practical and academic interest.

report is primarily based on the shark recorded during the years 1952 through During this period the POFI ships *John ning*, *Charles H. Gilbert*, and *Hugh M.* onducted 26 longline cruises, which ob- harks in the central Pacific between 50° N. S. latitude, and 110° W., and 175° E. le (fig. 1). During the same period of our privately owned, commercial vessels, *alieri*, *Commonwealth*, *North American*, *anic*, operating in conjunction with POFI, total of eight cruises to the Line Islands ata from all the above cruises were utilized en the shark catches were recorded by Although a considerable portion of these data have routinely been listed in reports by workers concerned primarily with tuna (Murphy and Shomura, 1953a, 1953b, 1955; Shomura and Murphy, 1955; Shomura and Otsu, 1956; Iversen and Yoshida, 1956), it seems advisable to provide a summary of the catch and effort for the various cruises (table 1).

METHODS

The longline gear used by POFI as a tool for sampling the abundance of tunas (and sharks) has been described by Niska (1953) and Mann (1955). A unit or basket of longline gear consists of 210 fathoms of mainline supporting a number of hook droppers, usually 3 fathoms in length, and buoyed at its end by floats attached to 5-, 10-, or 15-fathom floatlines. Numerous baskets are joined together to form a set, each basket being placed in the water in a slack condition so that the 210-fathom mainline sags and subtends a distance of only about 150 fathoms between floats. The number of droppers per basket was typically 6, 11, or 13, although experimental gear employing 14, 15, and 21 droppers was occasionally used during the period under consideration. Bait consisted of frozen herring, sardines, or squid. Setting of longlines usually started at dawn and required about an hour. Recovery commenced at noon and was usually completed in 4½ hours. The last basket set was the first one retrieved.

In their classic treatise on North Atlantic sharks Bigelow and Schroeder (1948) frequently refer to nomenclatorial confusion resulting in nonacceptability of shark records. This confusion has several causative factors, chief of which is the lack of large preserved specimens available for systematic study. Further complicating the situation is the existence of several sets of names for sharks, e. g., one set for Atlantic species, another

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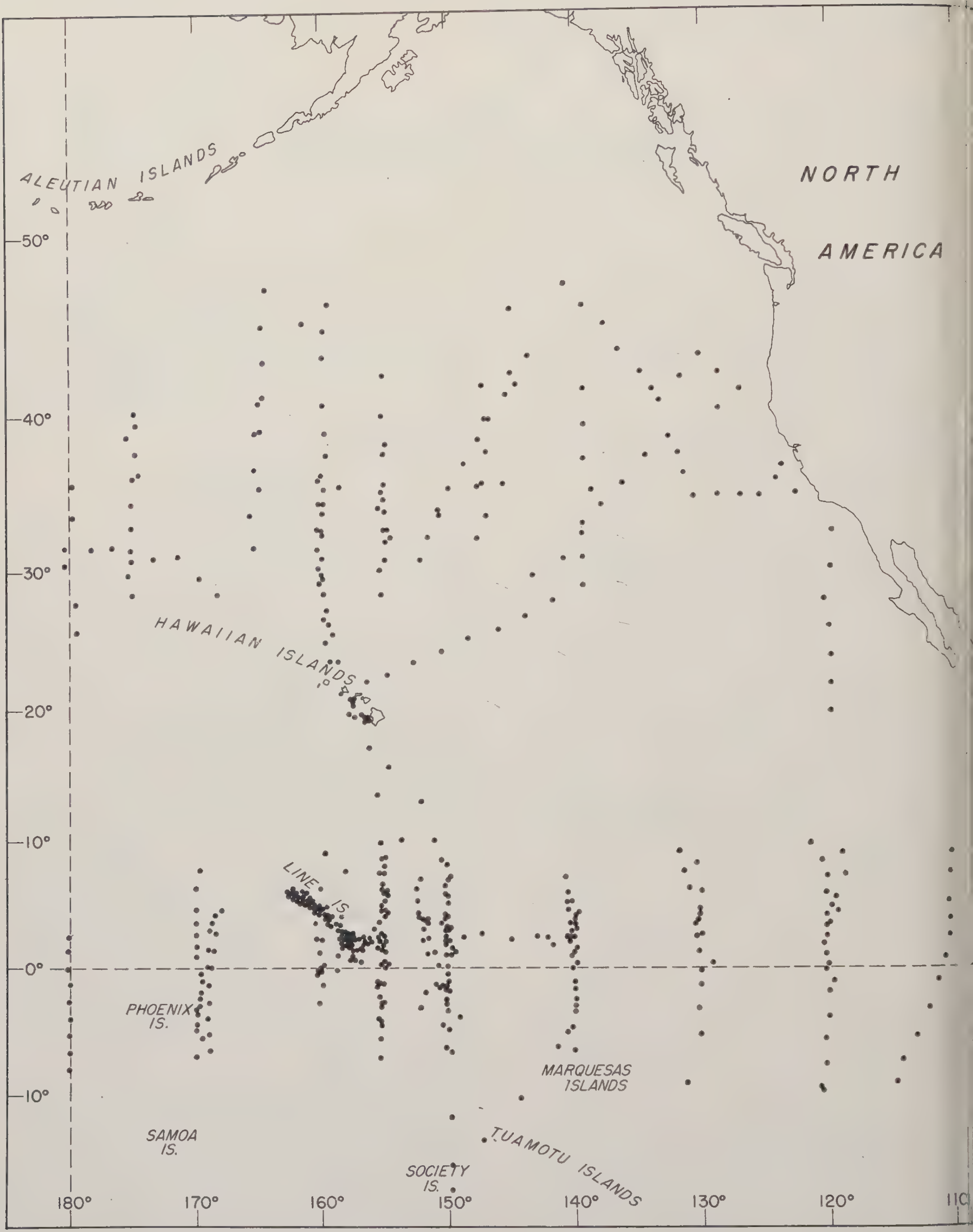

ALEUTIAN ISLANDS
NORTH
AMERICA
HAWAIIAN ISLANDS
LINE IS.
PHOENIX IS.
MARQUESAS ISLANDS
SAMOA IS.
SOCIETY IS.
TUAMOTU ISLANDS
50°
40°
30°
20°
10°
0°
10°
180°
170°
160°
150°
140°
130°
120°
110

FIGURE 1.—Location of longline stations from which the sharks reported on were obtained.

TABLE 1.—*POFI and commercial longline cruises yielding identified sharks during the period 1952–55*

essel	Cruise	General operational area [1]	Date	Number of stations	Total hooks	Shark catch			
						Great blue	White-tip	Silky	Other
Manning	11	Equator at 159° W., 169° W., 180°.	January–March 1952	27	6, 960	51	71	31	1
	12	Equator at 140° W., 150° W	August–September 1952	18	4, 560	13	59	5	8
	13	Equator at 150° W., 169° W.	October–November 1952	27	7, 620	20	131	19	0
	14	Equator at 140° W., 150° W	January–March 1953	33	8, 850	25	140	25	3
	15	Equator at 150° W., 170° W	April–June 1953	28	9, 521	47	109	42	9
	16	Equator at 155° W., 160° W	July–August 1953	26	8, 811	47	47	139	5
	17	Line Islands	October–November 1953	6	2, 418	2	2	48	1
	18	Equator at 155° W., Line Islands.	December 1953	14	7, 140	15	76	92	5
	19	22° N.–36° N., 145°.–160° W.	January–March 1954	18	14, 014	91	3	0	11
	20	Line Islands	May–June 1954	27	15, 764	32	108	268	3
	21	Hawaiian Islands	July 1954	5	2, 052	7	4	0	0
	22	22° N.–47° N., 159° W.–177° W.	September–October 1954	16	11, 869	170	1	0	6
	23	22° N.–37° N., 157° W.–180°	December 1954–February 1955.	18	13, 415	131	0	0	4
	24	Line Islands	March–April 1955	10	6, 422	15	32	79	7
	25	28° N.–41° N., 158° W.–175° W	May–June 1955	18	8, 318	229	0	0	23
	26	30° N.–47° N., 122° W.–152° W	July–September 1955	38	19, 609	719	0	0	16
	27	Line Islands	October 1955	11	6, 928	11	9	121	9
	28	do	November–December 1955	5	3, 955	7	25	35	0
H. Gilbert	1	Equator at 120° W., 130° W	May–June 1952	14	3, 360	16	32	16	0
	10	Hawaiian Islands	March 1953	3	623	4	2	0	0
	15	South of Baja California, and Equator at 110° W., 155° W.	February–April 1954	32	15, 271	323	31	51	8
	20	Line Islands	March–April 1955	14	9, 054	43	14	130	9
	23	36° N.–47° N., 145° W.–165° W	September–October 1955	8	4, 147	54	0	0	1
Smith	18	Equator at 120° W., 130° W	October–November 1952	23	5, 520	59	83	28	2
	19	Line Islands	January–February 1953	8	2, 160	6	3	68	1
	29	22° N.–42° N., 139° W.–156° W	May–June 1955	30	15, 600	218	0	0	14
wealth	1	Line Islands	July–August 1954	11	5, 500	2	28	54	3
	3	do	May 1955	11	3, 537	6	1	28	18
	4	do	July–August 1955	12	4, 095	7	1	102	5
	5	do	September–October 1955	10	4, 210	10	5	55	3
nerican	1	do	January–February 1954	27	21, 283	30	19	258	31
	2	do	March–April 1954	40	35, 965	58	86	347	23
	1	Equator at 140° W., 150° W	August–September 1952	26	11, 454	42	65	3	8
	1	Line Islands	June 1954	9	3, 762	2	0	132	6
					303, 767	2, 512	1, 187	2, 176	243

term "Equator" denotes fishing in the equatorial area, and not necessarily along 0°. The position of the Line Islands is bounded roughly by 0°–10° le and 155° W.–165° W. longitude.

rthwest Pacific species, a third for Hawai- rms, etc., a situation comparable to that for other pelagic fish such as the tunas, s, and flying fishes. For comparative pur- t is thus necessary to note the identification s and procedures and the disposition of the al upon which this report is based.

principal references used in making the ications were Bigelow and Schroeder's e (1948), supplemented by the reports of and Ripley (1950), Roedel (1953), and z et al. (1953). On early cruises sharks brought aboard, identified, measured, and ntly photographed. Occasionally jaws, s of skin, embryos, and entire adult speci- were preserved, and laboratory examination material has since confirmed the recorded entifications with the reservations that the "thresher" and "hammerhead" are based d 2 species, respectively. As biologists and en became better acquainted with the vari- cies fewer sharks were landed, and identi- was often based on the gross aspects of the animals as they lay in the water alongside the vessel. There is thus a possibility of an occasional error in identification, particularly with *Isurus glaucus* and *Lamna ditropis*, which are rather similar in appearance. Specimens of each species considered are to be shipped to the United States National Museum to serve as a permanent record.

The vernacular names of sharks are used throughout the remainder of this study. These names and their currently accepted scientific equivalents are as follows:

Whitetip shark	*Pterolamiops longimanus* (Poey).
Blacktip shark	*Carcharhinus melanopterus* (Quoy and Gaimard).
Silky shark	*Eulamia floridanus* (Bigelow, Schroeder, and Springer).
Great blue shark	*Prionace glauca* (Linnaeus).
Soupfin shark	*Galeorhinus zyopterus* Jordan and Gilbert.
Bonito shark	*Isurus glaucus* Müller and Henle.
Mackerel shark	*Lamna ditropis* Hubbs and Follett.

Thresher shark	*Alopias pelagicus* Nakamura. *Alopias superciliosus* (Lowe). *Alopias vulpinus* (Bonnaterre).
Hammerhead shark	*Sphyrna lewini* (Griffith). *Sphyrna zygaena* (Linnaeus).

Representative length-frequency distributions of the three most common pelagic sharks are shown in figure 2; these will acquaint the reader with the size of the sharks encountered. Insofar as possible common names have been taken from the list proposed by the American Fisheries Society (1948). For those species not covered by this list, vernacular names were derived from Bigelow and Schroeder's treatise (1948). Latin names follow the latter authors except for the carcharhinid genera lacking spiracles. Here Springer's revision (1950, 1951) has been employed with the result that the former *Carcharhinus longimanus* and *C. floridanus* are now referred to *Pterolamiops* and *Eulamia* respec
Identification of *Sphyrna lewini* was made
cordance with Fraser-Brunner's synopsis
hammerhead sharks (1950).

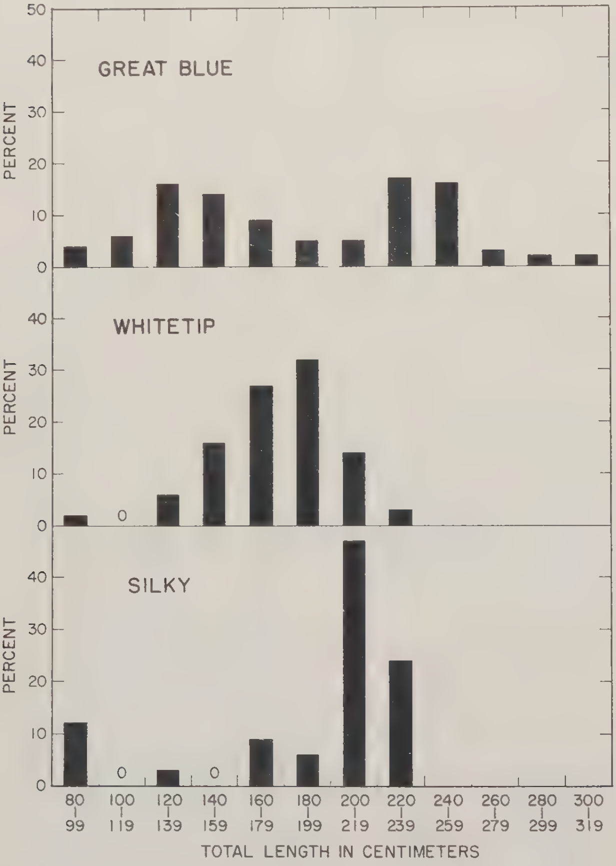


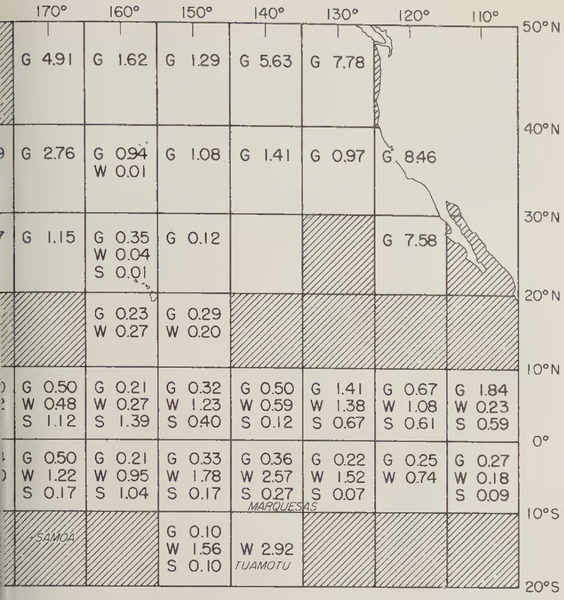
FIGURE 2.—Typical length-frequency distributions of pelagic sharks commonly occurring in longline catches in the central Pacific. Based on 106 great blue, 63 whitetip, and 34 silky sharks.

It was thought desirable to express shark
dance in terms of fishing effort, as averag
per hundred hooks per day for a certain
area. The operational region was accordin
vided into quadrates measuring 5 degree
side, and catch and effort were calculated fo
areal unit. Iversen and Yoshida (1956
Murphy and Shomura (1955) found diffe
in efficiency between two types of gear in ca
yellowfin tuna, but all gear types were her
sidered equally efficient in catching shark
frequently happened that longline fishing
tions were conducted along specified meridi
parallels, and these were also the boundar
quadrates. Usually, the line drifted with th
rent so that fishing was restricted to one
other of the quadrates, but when operatio
tually extended over two quadrates, the
catch was assigned to the quadrate in which
fishing appeared to take place. This assig
took into account set and drift of the cu
time spent in each quadrate, and vessel cour
speed. Similarly, stations occupying pa
more than 1 day were assigned the date on
most fishing was conducted. For ease in p
tation the data summarized by 5-degree qu
have been regrouped on a 10-degree basis a
used in this form throughout most of the ar

The author wishes to thank all POFI sc
and vessel personnel for their efforts in l
and handling the sharks on which this re
based. Collection of shark data was be
POFI by Dr. William F. Royce.

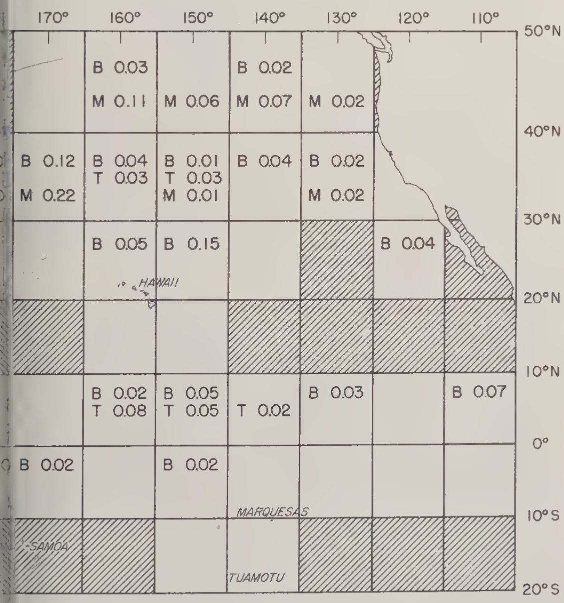
GENERAL RANGE AND ABUNDAN

The distribution and abundance of the c
Pacific pelagic sharks considered here are
marized in figures 3 and 4. It is apparen
high seas sharks are widely distributed as a
and that their abundance, expressed as av
catch per hundred hooks per day, is usuall
than that of tuna (Murphy and Shomura,
1953b, 1955; Shomura and Murphy, 1955;
mura and Otsu, 1956; Iversen and Yoshida,
On the other hand the present data indi
greater abundance of sharks than do th
Nomura et al. (Shomura and Murphy, 1955


170°
160°
150°
140°
130°
120°
110°
50°N
40°N
30°N
20°N
10°N
0°
10°S
20°S
G 4.91
G 1.62
G 1.29
G 5.63
G 7.78
G 2.76
G 0.94 W 0.01
G 1.08
G 1.41
G 0.97
G 8.46
G 1.15
G 0.35 W 0.04 S 0.01
G 0.12
G 7.58
G 0.23 W 0.27
G 0.29 W 0.20
G 0.50 W 0.48 S 1.12
G 0.21 W 0.27 S 1.39
G 0.32 W 1.23 S 0.40
G 0.50 W 0.59 S 0.12
G 1.41 W 1.38 S 0.67
G 0.67 W 1.08 S 0.61
G 1.84 W 0.23 S 0.59
G 0.50 W 1.22 S 0.17
G 0.21 W 0.95 S 1.04
G 0.33 W 1.78 S 0.17
G 0.36 W 2.57 S 0.27
G 0.22 W 1.52 S 0.07
G 0.25 W 0.74
G 0.27 W 0.18 S 0.09
MARQUESAS
SAMOA
G 0.10 W 1.56 S 0.10
W 2.92
TUAMOTU

URE 3.—Distribution and abundance of three com-
pelagic sharks. Abundance expressed as average
per hundred hooks per day; hatched areas not
led. *G*=great blue, *W*=whitetip, *S*=silky shark.

spection of figures 3 and 4 shows that the
t blue shark is wide ranging throughout the
considered whereas certain of the other spe-
occur within rather narrowly circumscribed


170°
160°
150°
140°
130°
120°
110°
50°N
40°N
30°N
20°N
10°N
0°
10°S
20°S
B 0.03 M 0.11
M 0.06
B 0.02 M 0.07
M 0.02
B 0.12 M 0.22
B 0.04 T 0.03
B 0.01 T 0.03 M 0.01
B 0.04
B 0.02 M 0.02
B 0.05
B 0.15
HAWAII
B 0.04
B 0.02 T 0.08
B 0.05 T 0.05
T 0.02
B 0.03
B 0.07
B 0.02
B 0.02
MARQUESAS
SAMOA
TUAMOTU

RE 4.—Distribution and abundance of three uncom-
pelagic sharks. Abundance expressed as average
per hundred hooks per day; hatched areas not
d. *B*=bonito, *T*=thresher (3 species), *M*=mack-
ark.

limits. In addition, the great blue is easily the most abundant shark in terms of POFI's longline catch, for its 2,512 records constitute about 41 percent of the entire shark catch. Its area of greatest abundance lies north of 20° N. latitude in the eastern part of the Pacific.

The bonito shark has almost the same range as the great blue shark (fig. 4), but as only 74 of the former were taken the catch was almost negligible when reduced to an effort basis. The present data indicate no centers of abundance for the bonito shark although Bigelow and Schroeder (1948: 129–130) list its Atlantic counterpart as a tropical and warm-temperate species which is particularly common in the Canary and Bahamas Islands (between 20° N. and 30° N. latitude).

The silky and whitetip sharks are equatorial species, the range of the former being practically restricted to a band about 10 degrees (600 miles) on either side of the Equator, whereas that of the latter is bounded roughly by 20° N. and 20° S. latitude (fig. 3). The total catch south of 10° N. latitude consisted of 4,157 sharks of which 2,175 (52 percent) were silkies and 1,173 (28 percent) were whitetips. Despite the fact that the catch contained nearly twice as many silkies as whitetips, in terms of catch-per-hundred-hooks in the open ocean areas the whitetip is actually the more abundant of the two species (fig. 3), thus confirming Hubbs' (1951) observation that it is common in the equatorial Pacific. As implied by Bullis (1955) and pointed out by Mather and Day (1954) and Backus et al. (1956), the whitetip rather than the great blue is probably the most abundant warm-water pelagic shark.

It is of interest that the silky shark was not reported from the Pacific until the tentative identification in 1953 (Murphy and Shomura, 1953b), and its presence there was confirmed in 1956 (Iversen and Yoshida).

The region of maximum abundance for the silky shark is centered around the Line Islands area (between 0° and 10° N. and 155° W. to 165° W.), which is also the center of abundance of equatorial yellowfin tuna (Sette 1955). Whitetip concentration is more diffuse, the species being more strictly oceanic (Bigelow and Schroeder, 1948), and not congregating near land (most longlining in the Line Islands was conducted quite close to land). It has been postulated that the whitetip's oceanic existence represents a general avoidance of reduced salinities (Bigelow and Schroeder, 1948), but Backus et al. (1956) found the whitetip occurring over a wide salinity range and alternatively suggested that land avoidance may simply be the result of unfavorable food competition with faster-moving neritic species.

The catch data for the mackerel shark consist of 28 records, 26 of which are from north of 35° N. latitude indicating that this shark is a temperate- or cold-water form (fig. 4). Not shown in figure 4 is a single record from the Line Islands which is most likely based on a misidentified bonito shark.

Little can be said of the distribution and abundance of central Pacific thresher sharks except that they are uncommon (only 127 were taken) and have a tendency to congregate near land in the equatorial region as is shown later. All three species (*Alopias pelagicus*, *A. superciliosus*, and *A. vulpinus*) were taken within about 300 miles of Christmas Island in the Line Islands group, but the identity of the boreal records shown in figure 4 could not be determined.

No distributional charts were prepared for soupfin, hammerhead, or blacktip sharks as only 8, 4, and 2 specimens, respectively, were taken. The soupfins were obtained off the coast of southern California, 1 hammerhead (*Sphyrna lewini*) came from the area bordered by 0°–5° N., 120°–125° W., another (*S. zygaena*) was from 0°–5° N., and 110°–115° W., and 2 others, identified only as "hammerheads," were obtained just east of the Line Islands. The 2 blacktips were taken near shore in the Marquesas Islands, and this species should not be regarded as oceanic (Schultz et al. 1953: 15).

VARIATIONS IN SHARK ABUNDANCE WITH LATITUDE AND SEASON

Geographical variations in abundance were examined by plotting average catch per unit of effort for 10-degree bands of latitude, and temporal variations were studied by recording the data by season. The northern seasons (spring, Mar. 21 to June 20; summer, June 21 to Sept. 20; autumn, Sept. 21 to Dec. 20; winter, Dec. 21 to Mar. 20) were used with the assumption that antipodal season-reversal would not be significant in the latitudinal distribution considered. For the uncommon species (bonito, mackerel, thresher
hammerhead, soupfin, and blacktip sh
seasonal subdivision resulted in so few
per season that very little was indicated.
consequence this section deals with the
abundant species, the great blue, the whitet
the silky.

In the Pacific, heavy concentrations o
blues occur only north of about 20° N. la

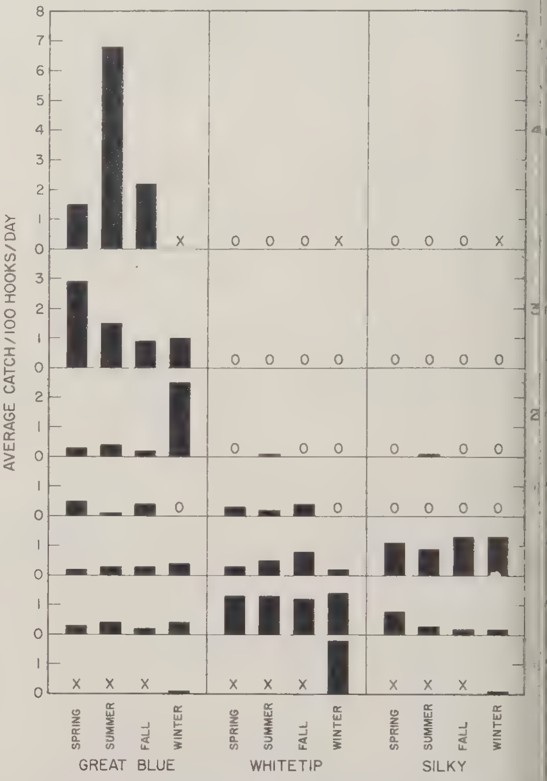


FIGURE 5.—Abundance of pelagic sharks by lati
season. Based on 2,512 great blues, 1,187 white
2,176 silkies. X=no fishing effort, O=no catch.

(figs. 3, 5). Since the southern limits of o
pling lay between 15° S. and 20° S. it is
sible to say whether similar concentratio
exist in the Southern Hemisphere. In the A
large numbers of great blues have been re
from both high and low latitudes (Bigelo
Schroeder, 1948), and the species is parti
numerous off the west coast of South Af
about 30° S. latitude (Smith 1950).

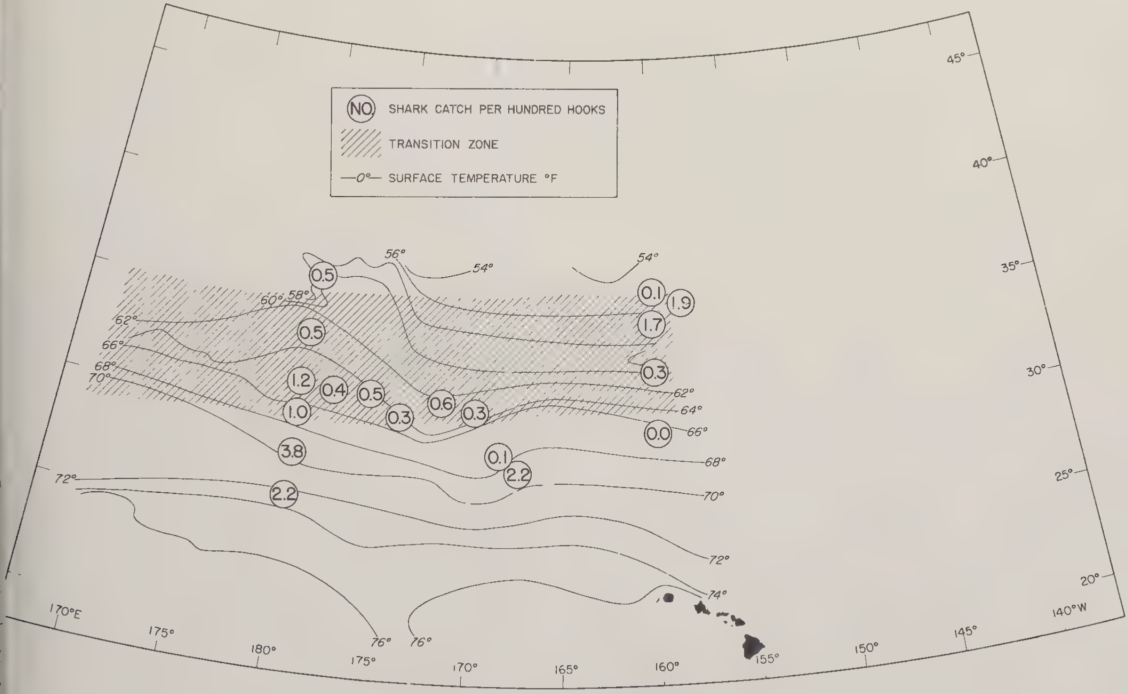
When the seasonal aspects of great blue di
tion are considered (fig. 5), it appears that f
tions are small or absent in the warm wa
tween 20° N. and 20° S. Between 20° N.

e species is most common in the winter, from . to 40° N. in the spring, and from 40° N. to . in the summer. These varying spatial and oral concentrations indicate a north-south ation of this species, and judging from the ve constancy of its numbers in the Tropics, we ce that temperature changes are their basis.

pointed out by Shomura and Otsu (1956) exists in the North Pacific a latitudinally ing transition zone between the relatively Aleutian Current and the relatively warm h Pacific Current. This zone lies between ides 31° N. and 36° N. in the winter, and een latitudes 41° N. and 46° N. in the fall 3). Shomura and Otsu (ibid.) indicate that ore move north and south with the advance etreat of this zone, and the present data show reat blue sharks do also. Most of the larger es of the great blue were made in or just south e transition zone in water with surface tem- ures ranging from 56° to 74° F., depending e season (fig. 6). This range of surface tem- ures cannot be considered as limiting their aphical occurrence because many great blues taken from deeper, cool water in the Tropics . 344).

Returning to figure 5, seasonal migrations of the great blues apparently extend only as far south as 20° N., although the absence of these sharks from the winter catch between 10° N. and 20° N. may indicate that migration also occurs there. With the onset of autumn a return southern migration presumably takes place, but this may occur outside the fishery since it is not evident from the catch data. It would seem that the number of northern migrants is augmented from populations extralimital to this study, otherwise it is difficult to explain the disparity between summer abundance at 40° N.–50° N. and spring abundance at 30° N.–40° N.

There is also the likelihood that the increase in numerical abundance in the areas to the north is the result of females giving birth to young. Large numbers of very small great blues were captured by longline in the areas during the spring, summer, and autumn. The smallest of these were about a foot and a half in total length, exactly the same size as large embryos (p. 354), and there can be little doubt that they were born shortly before capture. Unfortunately, length measurements were not routinely recorded for sharks and it is impossible to state what percentage of the popu-



DECEMBER — FEBRUARY

6a.—Relation between the great blue shark catch rate and position of transition zone, December–February. (After Shomura and Otsu, 1956.)

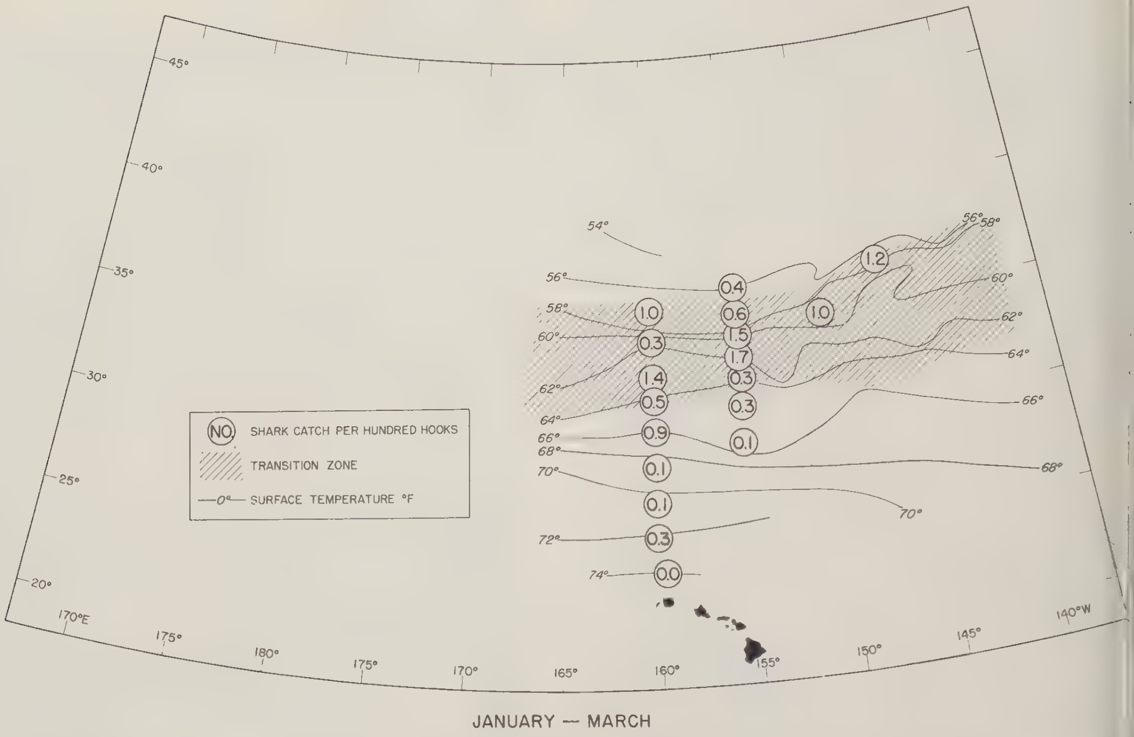

45°
40°
35°
30°
25°
20°
54°
56°
58°
60°
62°
64°
66°
68°
70°
72°
74°
56° 58°
60°
62°
64°
66°
68°
70°
1.2
0.4
1.0
0.6
1.0
0.3
1.5
1.7
1.4
0.3
0.5
0.3
0.9
0.1
0.1
0.1
0.3
0.0
NO. SHARK CATCH PER HUNDRED HOOKS
TRANSITION ZONE
0° SURFACE TEMPERATURE °F
170°E
175°
180°
175°
170°
165°
160°
155°
150°
145°
140°W
JANUARY — MARCH

Figure 6b.—Relation between the great blue shark catch rate and position of transition zone, January–March. Shomura and Otsu, 1956.)

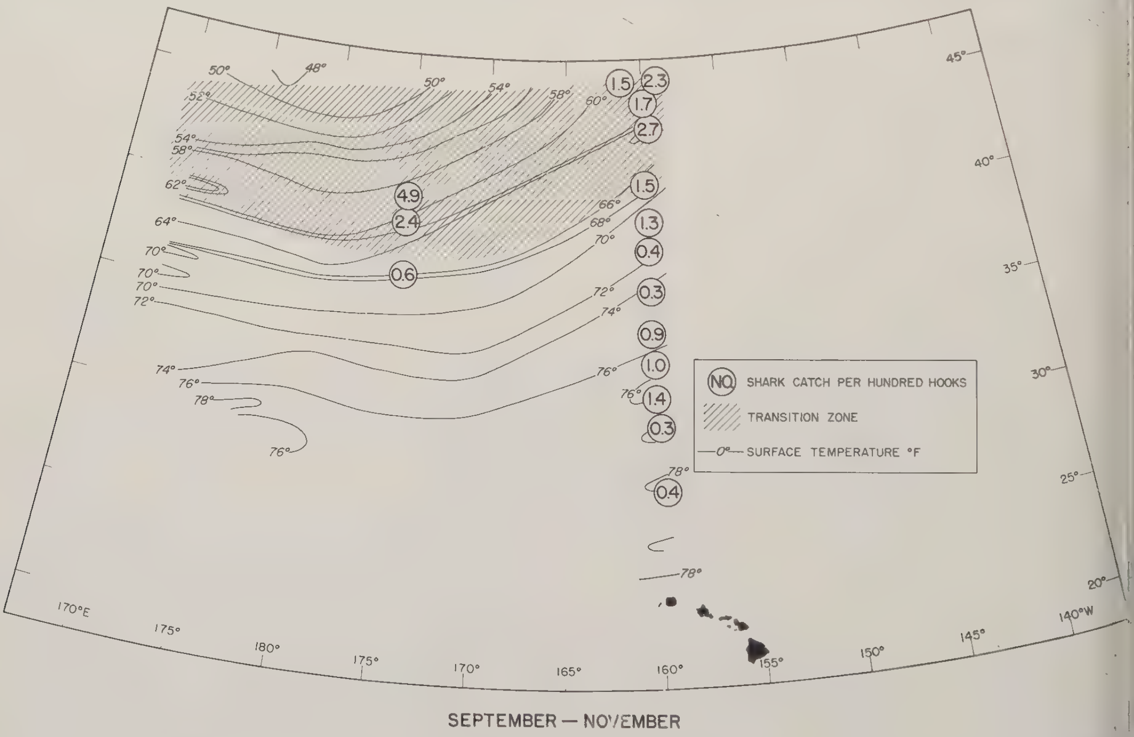

50°
48°
50°
54°
58°
60°
52°
54°
58°
62°
64°
70°
70°
70°
72°
66°
68°
70°
72°
74°
74°
76°
78°
76°
76°
76°
78°
78°
1.5
2.3
1.7
2.7
1.5
4.9
2.4
1.3
0.4
0.6
0.3
0.9
1.0
1.4
0.3
0.4
45°
40°
35°
30°
25°
20°
NO. SHARK CATCH PER HUNDRED HOOKS
TRANSITION ZONE
0° SURFACE TEMPERATURE °F
170°E
175°
180°
175°
170°
165°
160°
155°
150°
145°
140°W
SEPTEMBER — NOVEMBER

Figure 6c.—Relation between the great blue shark catch rate and position of transition zone, September–Nov
(After Shomura and Otsu, 1956.)

n was newly born. The fact that small great s were rarely encountered in warmer waters ests that migrations may be a reproductive omenon having a close relation to the position e transition zone.

e present data are inadequate for a discussion e longitudinal aspects of migration.

e whitetip and silky sharks, occurring as they lely within the Tropics, do not exhibit marked uations in abundance. Figure 5 indicates within the limits of our sampling, whitetip ers are greatest between 0° and 10° S., eas the area of maximum silky concentration etween 0° and 10° N. In neither region is much change in numbers during the year. significance of the large winter catch of white- between 10° S. and 20° S. cannot be deter- d until more seasons are represented in the data. Peripheral to these areas of concen- n there is some evidence of seasonal fluctua- the whitetip being more numerous in the er to the north, and the silky more numerous e spring to the south. Finally, the most erly records of each species were obtained in mmer.

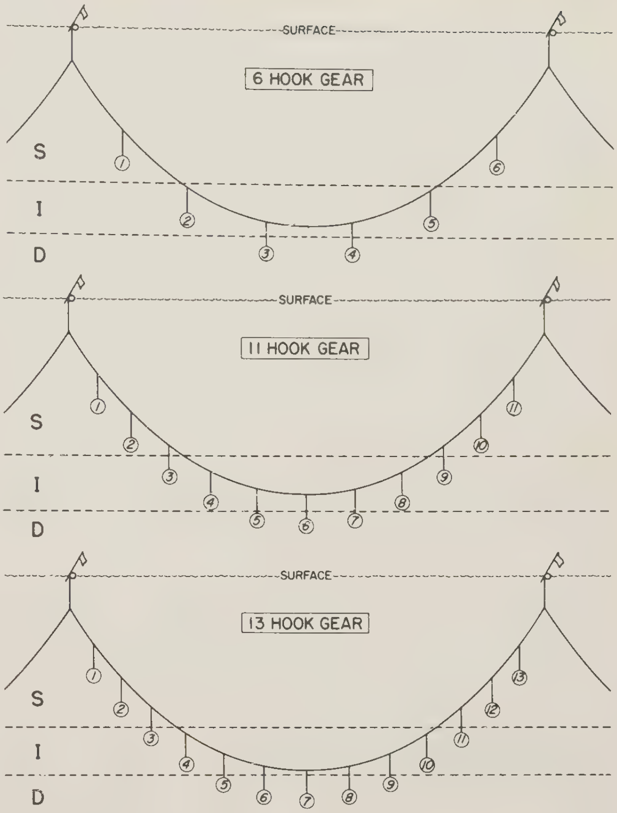


Figure 7.—Arrangement of a unit (basket) of each of the three types of longline employed in this study, showing floatlines, mainline, hook-bearing dropper lines, and the general lay of the gear with respect to the surface. Relative hook depths are indicated as shallow (*S*), intermediate (*I*), and deep (*D*).

Table 2.—*Depth assignment of hooks*

Type of gear	Relative depth and hook number			Relative weight applied to depth categories
	Shallow	Intermediate	Deep	
6-hook	1, 6	2, 5	3, 4	1:1:1
11-hook	1, 2, 10. 11	3, 4, 8, 9	5, 6, 7	¾:¾:1
13-hook	1, 2, 12, 13	3, 4, 10, 11	5, 6, 7, 8, 9	1:1:⅘

DISTRIBUTION BY DEPTH

hough the use of chemical sounding tubes to ain the fishing depth of the longline am and Stewart[1]) is now standard pro- on POFI cruises, such information was not ble for the majority of the cruises on which port is based. The vertical distribution of has accordingly been evaluated from the e depth of the hook of capture. The use plicability of this method have been dis- by Murphy and Shomura (1953a, 1953b, and Shomura and Murphy (1955), and the ent employed here is similar to that used se authors. Hooks were classified as shal- termediate, and deep, but because the num- hooks per basket varied between cruises it cessary to weight each category in inverse tion to the number of hooks involved. The ement of hooks within a basket for the three f longline used and the relative hook depths strated in figure 7. Table 2 summarizes hook number, relative depth, and relative weight for the three types of gear considered.

The actual depths implied by shallow, intermediate, and deep have been estimated from the data of Murphy and Shomura (1953a), Iversen and Yoshida (1957) and Stewart and Graham,[2] for 6-, 11-, and 13-hook gear, respectively. Although the depth categories are not strictly comparable between the three gear types, the following ranges are illustrative of the depths sampled:

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ating the maximum fishing depth of longline gear nical sounding tubes, by Joseph J. Graham and Dorothy rt. U. S. Fish and Wildlife Service. (Manuscript.)

[2] Unpublished data in files of Pacific Oceanic Fishery Investigations.

shallow, 160 to 280 feet; intermediate, 280 to 430 feet; and deep, 370 to 500 feet. Pooling of results from different kinds of longline gear was minimized by selecting data by latitude and gear type. All catch records from north of 30° N. latitude were derived from 13-hook gear, whereas the majority of records south of 20° N. latitude were based on 6-hook gear, with a few catches from 11- or 13-hook baskets. Between 20° N. and 30° N. latitude the catches from only 11- and 13-hook gear were analyzed. Shark catch expressed as percentage occurrence on shallow, intermediate, and deep hooks is presented graphically in figure 8.

The great blue is wide-ranging and as such would be expected to be broadly eurythermal (fig. 3). The depth distribution data shown in figure 8 are at variance with this in that they sho species as being taken mainly on shallow in the northernmost parts of its range, and ly on deep hooks south of the Equator. Num observations of free-swimming great blue firm this depth distribution picture, for the was frequently seen swimming at the surf the north but never so in the Tropics (no in pursuit of a hooked and bleeding tuna). shift in vertical distribution is possibly ample of "tropical submergence," and im narrower degree of eurythermality for the s Lines of evidence supporting this idea are lows.

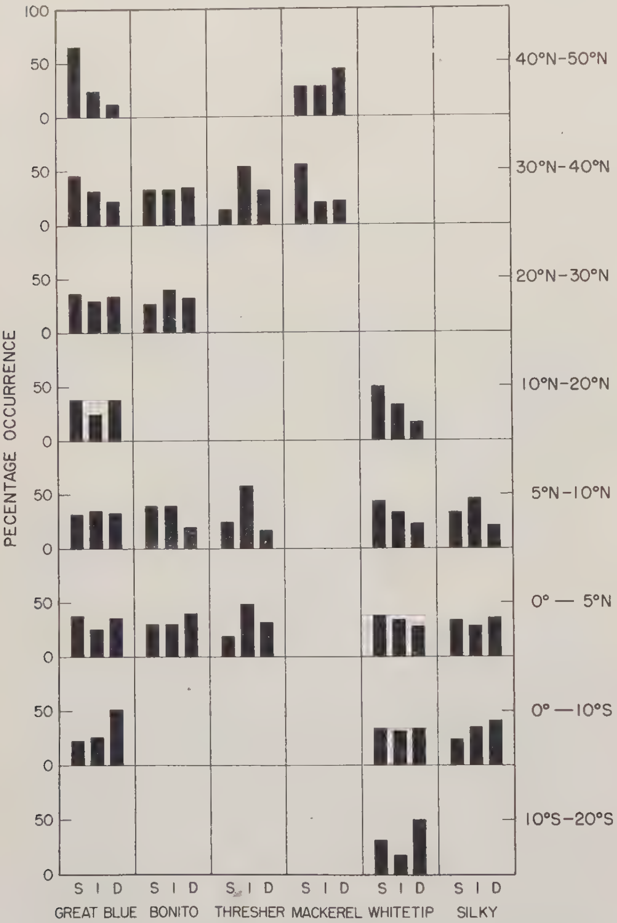

Figure 8.—Vertical distribution of pelagic sharks by latitude. Histograms depict percentage occurrence on shallow (S), intermediate (I), and deep hooks (D). Data are based on following catches: 1,318 great blues, 33 bonitos, 486 whitetips, 311 silkies, 27 mackerels, and 62 threshers.

Stewart and Graham [3] have calculated ten tures for the depth of capture of 1,200 grea sharks taken north of 25° N. From their da frequency of occurrence of great blues in 5-d temperature categories was as follows:

Temperature:	*Frequ of occu great blu*
40° to 44° F.	
45° to 49° F.	
50° to 54° F.	
55° to 59° F.	
60° to 64° F.	
65° to 69° F.	
70° to 74° F.	

Ninety-nine percent of the above sharks wer temperatures between 45° and 69° F., a percent were captured in or below the therm These temperature data are biased to an un degree on the cold side (they were derived estimated maximum hook depths), but they theless indicate that temperatures between 45° and 69° F. are preferred by the gre shark. When the depths of the 45°–69° therms are examined by latitude (c. f. Mc al., 1956; Cromwell 1954) it is seen that iso in the range 50°–69° F. follow the vertical bution of the great blue (fig. 8). These iso either reach the surface or are very shall tween 40° N. and 50° N. latitude but gra deepen to the south, ultimately lying as de deeper than the deepest hooks (this occu tween 20° N. and 30° N. where the isotherm range is roughly 500–800 feet). The 50°– isotherms continue at this depth as far sou the scope of this study except for a marked lowing at about 10° N. latitude where the h to within 200–600 feet of the surface. broad depth range here renders their shoal- nsignificant, and the great blue's depth dis- ion does not show an accompanying shal- g.

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[3] Unpublished data in files of Pacific Oceanic Fishery gations.

other factor which could account for the in- ed surface abundance of the great blue to the is a pronounced seasonal increase in the food y. Although no direct measures of the ing crop of shark forage (principally small nd squid) are presently available, an idea of tential magnitude can be obtained from vari- in zooplankton abundance (McGary et al., 24–26). Between Midway Island and 40° itude zooplankton volumes were about equal lique hauls from 0 to 40 meters, which sam- ntirely above the thermocline, also for hauls from the surface to 140 meters and hence, ng or penetrating the thermocline; in addi- he average volume per haul was uniformly (16–27 cubic centimeters per 1,000 cubic s strained) at these latitudes. Between 40° 45° N. latitude the shallow hauls yielded 1.5 times as much zooplankton as the deeper and the volume of the catches increased to erage of 64 and 44 cc., respectively. From to 50° N. latitude, the shallow hauls caught imes as much zooplankton as the deeper and average volumes increased to 168 and respectively. This marked increase in sur- oplankton toward the north is similar in l respects to the distributional picture seen sharks themselves.

vertical distribution of bonito, mackerel, resher sharks, shown in figure 8, is based on cords and is probably not very reliable. and thresher sharks appear to be euryther- t three species are involved in the latter status of each is dubious. The only expla- offered for the apparent latitudinal shift ical distribution of the mackerel shark are t the data may be misleading because of all sample size (12 and 15 specimens), or t both the shallow- and deep-hook catches rom about the same temperature. With ce to the data of McGary et al. (1956), it that between 40° N. and 50° N. latitude at depths the isotherms are very steep so that e deep and shallow hooks could fish in f the same temperature.

In common with the other species occurring in the equatorial area, neither the whitetip nor the silky shark shows much latitudinal change in vertical distribution. The whitetip appears to be principally a surface dweller north of the Equator and more bathypelagic to the south, whereas the silky is almost uniformly distributed in depth to the north and is more deep-swimming to the south. The shoaling of the 60°–70° F. isotherms to 200–400 feet at about 10° N. latitude (Cromwell 1954) may explain the whitetip's shallow distribution in that general area, and similarly the deepening of isotherms south of 5° S. latitude could account for both sharks' deeper occurrence there.

VARIATIONS IN ABUNDANCE WITH LONG-TERM TEMPERATURE CYCLES

In the foregoing paragraphs frequent mention has been made of temperature as a factor regulating the spatial distribution of certain sharks. It is of interest, therefore, to examine abundance fluctuations in an area where temperatures are well known and relatively constant, and where shark numbers might be expected to vary directly or indirectly (through food chains, competition, etc.) with slight thermal changes. The region selected for this was the band of equatorial water extending from about 175° E. longitude to 110° W. longitude and bordered by 10° N. and 10° S. latitude. Shark catches from this region were segregated by species, year, and month, reduced to an effort basis, and plotted as anomalies between monthly means and the 4-year mean for each of the three common species. Similar data for surface temperature have been compiled by T. S. Austin, who has kindly made them available to this study. It should be noted, however, that the temperature anomalies are derived from a 6-year mean. Figure 9 shows the relation between shark abundance and temperature fluctuations.

As can be seen from figure 9, the years 1952 and 1953 were characterized by relatively warm surface temperatures (although quite variable in 1952), and 1954–55 by relatively cold conditions. The abundance of both whitetip and great blue sharks was greater during the warm years and lesser during the cold years, the same situation as found for yellowfin tuna.[4] Silky shark abund-

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[4] Murphy and Shomura, unpublished data.

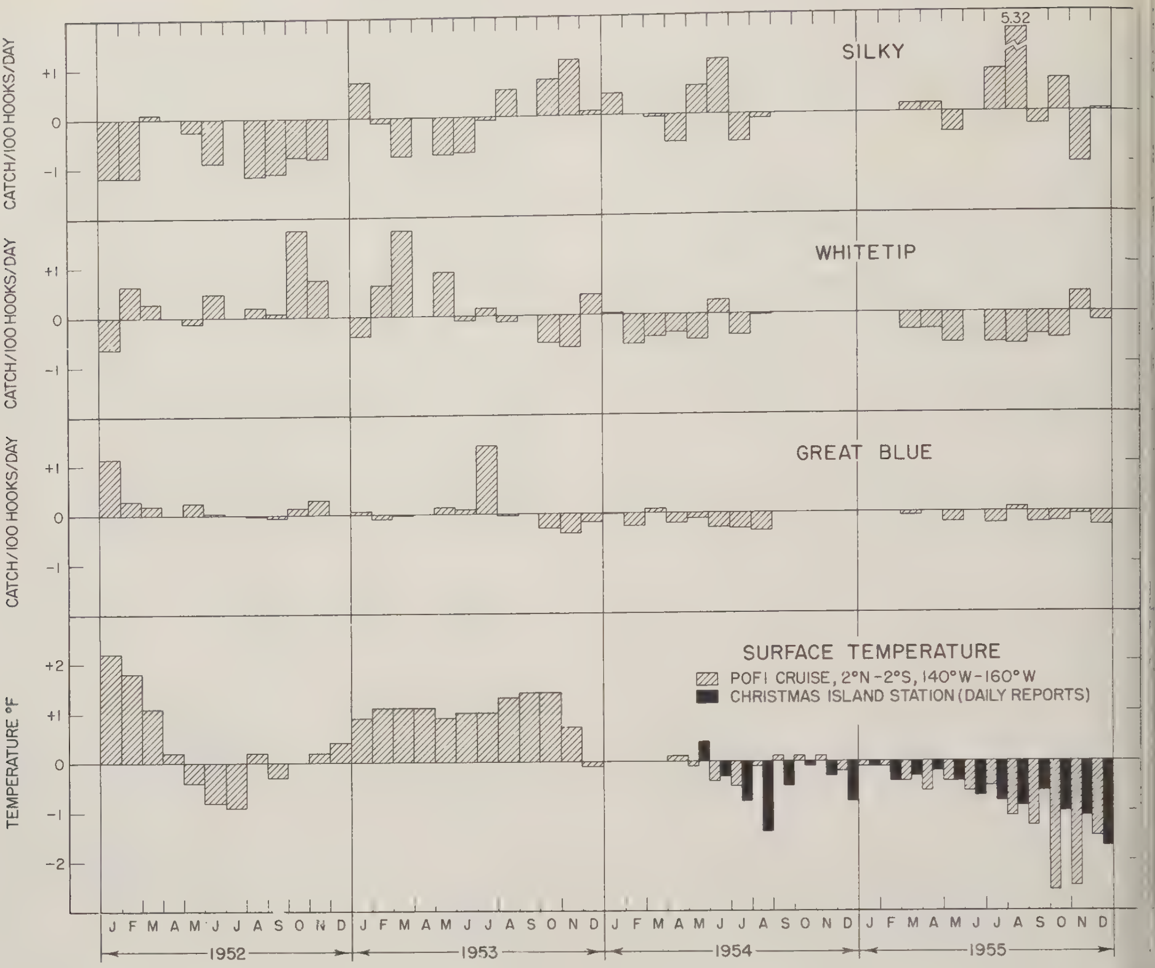


FIGURE 9.—Relation between shark catch and surface water temperature in the equatorial area. Shark his depict monthly deviations from 1952–55 means, based on entire catch between 10° N. and 10° S. latitude perature histograms show monthly deviations from 1950–55 means.

ance, on the other hand, appears to be complementary to the other two, but why this should be so is difficult to understand. From the standpoints of latitudinal and depth distribution (figs. 3 and 8), the silky and the whitetip are similar although the silky shark has a narrower latitudinal range. One would assume, on an a priori basis, that the silky was more dependent on warm temperature than the whitetip, and would further deduce that a reduction in its numbers would be brought about by colder rather than warmer water.

Perhaps a portion of the irregularity in the catch data stems from sampling artifacts, for several types of longline gear were in use and fishing was both insular and oceanic. In several instances where whitetip and great blue abundance was anomalous with respect to temperature (n the last 6 months of 1953) silky shark abu retained its complementary relation to the two species, and did not follow the tempe fluctuation. This may represent a behavio teraction between the silky shark and one o of the others. A similar situation involving same sharks is discussed in a later section d with abundance versus distance from land.

VARIATIONS IN ABUNDANCE W LONGITUDE IN THE EQUATO PACIFIC

A large portion of POFI's research pr has been devoted to an evaluation of the fi resources of the equatorial region of the c Pacific. Intensive sampling of fish stocks, and the physical and chemical environment been undertaken, and a considerable body of vledge of the interrelationships of these prop- s has been assembled. Physically the region aracterized by the easterly flowing Equatorial itercurrent between 5° N. and 10° N. latitude, by the westerly flowing South Equatorial ent to the south of this. Between 5° N. and Equator there exists a zone of enrichment h reaches optimum conditions, biologically king, between 140° W. and 160° W. longitude. the sequence of trade winds, divergence, and lling brings nutrient-rich water into the otic zone, with a resultant increase in bio- al productivity. An increase in abundance s area has been shown for zooplankton (King Demond, 1953), tuna (Murphy and Shomura, , 1953b, 1955; Shomura and Murphy, 1955), ea birds (King and Pyle, 1957) so it would e surprising to find a similar increase in the er of pelagic sharks.

examine further the geographic variation in abundance the catch records for all species reduced to terms of average catch per hun- ooks per day for 5-degree intervals of lati- nd 10-degree intervals of longitude between . and 10° S. latitude, and 175° E. and W. longitude (fig. 10). The 4,133 records ered include 2,174 silky, 1,151 whitetip, 641 blue, and small numbers of bonito, thresher, erhead, and blacktip sharks. Because of the of land on species composition the species ere pooled.

he region of the Equatorial Countercurrent to 10° N. in the central Pacific) shark num- nerally decreased from east to west, the con- ion of this decline being nearly identical to ound for zooplankton volumes (King and 1957). A difference between the zooplank- l shark abundance patterns is that the form- s at 140° W. and declines east of that point, s shark abundance appears to be minimal W. and to rise to the eastward. Because generally close correlation between shark s and zooplankton volumes it would seem sic food abundance, and not temperature imity to land (see p. 348) is the factor in- g shark distribution in the Countercur- ea. King and Hida (loc. cit.) state that -to-west decline in zooplankton parallels a decrease in surface enrichment caused by a slackening of wind and deepening of the thermocline.

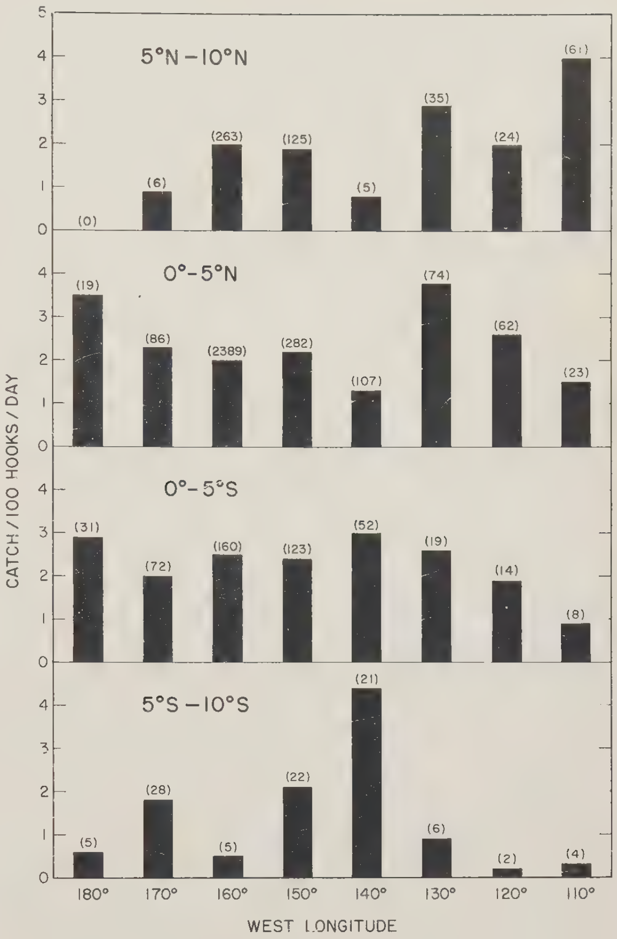


Figure 10.—Abundance of pelagic sharks in equatorial waters, all species combined. Each histogram depicts abundance for the area 5 degrees on each side of the numbered coordinate of longitude and within each 5-degree band of latitude. Numbers in parentheses represent actual catch.

Between 5° N. and 5° S. (South Equatorial Current) there are two types of distributions in the biotic indices. One involves a gradual doming of abundance with maximal values occurring between 140° W. and 160° W., the other the reverse situation with minimal values occurring at these central longitudes, and increases to the east and west. King and Hida (1957) found the first type for yellowfin tuna and zooplankton, and it also occurs for sharks between the Equator and 10° S. (fig. 10). The second situation obtains for inorganic phosphate (King and Hida, loc. cit.) and for sharks between 5° N. and the Equator. It is difficult to reconcile these seemingly antithetical patterns, for one would presume the distribution of organisms high in the food chain to correspond closely to that of the nutrients below them. Perhaps the decline in shark numbers at 140° W. longitude is brought about by food competition between sharks and yellowfin tuna. As shown by Murphy and Shomura (1955), yellowfin are particularly abundant at this longitude between the Equator and about 7° N. latitude. South of the Equator there is close agreement between the longitudinal distributions of sharks, yellowfin tuna, and plankton.

SHARK DISTRIBUTION WITH RESPECT TO LAND

The effect of land or proximity of land on the distribution of a pelagic marine animal provides an interesting problem. For certain oceanic species the presence of land acts only as a barrier to movements, whereas others congregate about islands and other land masses to feed or to reproduce. It occasionally happens that oceanic fish abound in insular environments, either because of the islands' intrinsic nutritive richness or because they lie in the path of rich oceanic currents. The latter situation is apparently true for Christmas Island, a member of the Line Islands group. Here an atoll is located in the path of flow of enriched equatorial water, and maximum abundance of yellowfin tuna occurs in a narrow band extending from Christmas eastward for several hundred miles (Sette 1955).

The POFI longline surveys have provided information on the distribution of sharks in relation to nearness of land. Proximity to land was determined by measuring the distance between the noon position of a fishing station (recovery of longline gear usually started at noon) and the nearest portion of Christmas Island. Shark abundance in neritic situations is contrasted with that of the open ocean in figure 11.

Three distributional patterns are apparent for the sharks shown in figure 11. The thresher sharks (3 species) are definitely neritic, their abundance falling close to zero 40 miles from shore. The silky shark (noted as semipelagic, Springer 1950) occurs in moderate numbers on the high seas but is about twice as plentiful in the neritic region. Two sharks, the whitetip and the great blue, are truly oceanic species, and numbers steadily increase as land is left behi

The zone delimited by the categories 10–1 50–59 miles from land is essentially a region the physical and ecological characteristics o neritic and oceanic provinces intergrade. It interest that in this transitional area none o sharks considered exists in the same degr abundance as it does in more landward or se locales. Perhaps the intermediate nature physical environment favors neither the nerit the oceanic species, or perhaps abundance fl tions represent biotic interaction between more sharks and other organisms. If the then interaction is most likely in the realm o competition, for predation and other immed deleterious relationships are probably in quential for large sharks.

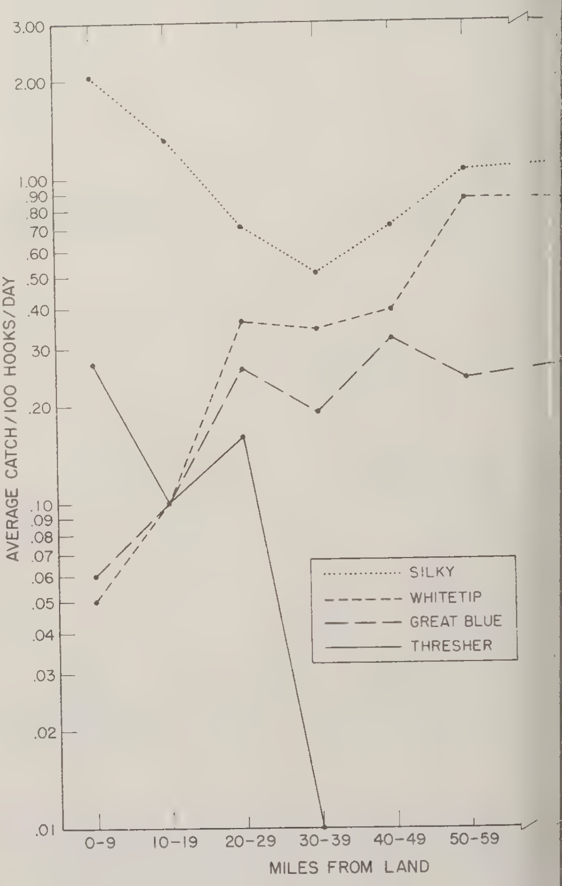


FIGURE 11.—Abundance of pelagic sharks with to distance from land. Data derived from Ch Island area and region to eastward between 1° 3° N. latitude. Based on 997 silky, 210 whitetip, 1 blue, and 86 thresher sharks.

e species of sharks discussed here subsist
ipally on small fish and squid and have
liet in common with yellowfin tuna (Reintjes
King, 1953) and bigeye tuna (King and Ike-
1956). As to swimming speeds, it would ap-
almost certain that the tunas are much faster
the sharks, and that among the sharks them-
there may be considerable differences in
. It has been suggested that whitetips are
vely slow swimmers compared to silky sharks
kus et al., 1956), with the whitetip's cruising
being estimated at about a mile an hour by
burg (1957). Also confirming this slowness
fact that, although several silky sharks have
taken while trolling at 6 to 8 knots, only 1
tip was so captured during several thousand
of trolling by POFI vessels. This lack of
would place the whitetip in an unfavorable
titive position with both the yellowfin tuna
he silky shark, the abundance of each of
increases as Christmas Island is approached
Shomura and Murphy, 1956 for yellowfin
It appears, therefore, that the generally in-
relation between whitetip and silky abun-
shown in figure 11 may represent a competi-
teraction between the two.

OD HABITS OF PELAGIC SHARKS

fact that sharks are broadly carnivorous is
n knowledge, but the food of many of the
c species is not particularly well known.
Unfortunately, the stomach contents of longline-caught sharks were not routinely examined by POFI, and as a consequence the ensuing discussion is not based on a large body of data. Another factor reducing the number of records is that more than half of the 265 stomachs examined were empty. A summary of the results of our food study is presented in table 3.

As evidenced by the information in table 3, pelagic sharks subsist mainly on small fish and squid. Bigelow and Schroeder (1948) and Backus et al. (1956) have shown that the whitetip and bonito sharks also consume large fish such as tuna, and this is also indicated by the present data. In the present case, however, it could not be determined whether tuna were only preyed on after they had been hooked. The more neritic silky shark included littoral forms such as *Diodon* and crabs in its diet, and other sharks did the same in suitable locales. One tendency not shown in table 3 is that a number of thresher sharks were foul-hooked by the tail. Their capture probably resulted from attempts to herd the dangling bait with their tails (Breder 1929).

Pelagic sharks as a group are opportunistic feeders, commonly taking almost any available food, and often ingesting articles of little or no nutritive value. Several species tend to congregate around ships, and have been seen to swallow such items as paper cartons, tin cans, and scraps of cloth, along with considerable amounts of

TABLE 3.—*Food of longline-caught sharks*

	Number of stomachs in which occurred—																													
	Fish													Longline bait			Flying fish eggs		Cephalopods			Miscellaneous					
ecies	*Alepisaurus* (Lancet fish)	*Neothunnus* (Yellowfin tuna)	*Katsuwonus* (Skipjack)	Unidentified tuna	Tuna-like fish	*Diodon* (Spiny puffer)	*Mola* (Ocean sunfish)	Bramids (Pomfrets)	Echeneids (Sucker fish)	Myctophids (Lantern fish)	Ostraciids (Trunkfish)	Stingray	Unidentified fish	Herring	Sardines	Unidentified bait	Attached to feathers	Unattached	Squid	Octopus	Unid. cephalopods	Crabs	Shrimp	Sea bird (booby)	Blubber (?)	Number of empty stomachs	Number of stomachs examined
	5								1	1	1		25	4	10		4	2	19	1	20	2	2	1	1	76	140
	2	1		2				1				1	6	2	24				10	1	2					35	73
						2							1		2				3			1				22	29
	1	1			1		1						1			1			2							6	13
	1		1										3	2					1							2	7
													1													0	1
d:																											
na				1																						0	1
i													1						1							0	1
	9	2	1	3	1	2	1	1	1	1	1	1	38	8	36	1	4	2	36	2	22	3	2	1	1	141	265

garbage and fish scraps. The indiscriminate nature of this type of feeding suggests a low degree of visual (and olfactory?) acuity coupled with voracious feeding behavior, both of which are well known for sharks, and which would seem to belie their ability to capture squid, tuna, and sea birds unless these were moribund or dead. On the other hand, the author has seen a team of 2 or 3 whitetips slowly herd and capture squid around a surface light at night, and has also removed large pieces of tuna flesh from whitetip stomachs in areas where no fishing was taking place. Finally, a bigeye tuna (*Parathunnus sibi*) captured on a POFI longline cruise bore a pair of large U-shaped scars suspiciously resembling shark jaws in shape. The indications are that some pelagic sharks can be both fast moving and selective feeders, and perhaps the unpredictable
rapacity of their feeding enables them to
what would seem to be elusive, highly moti

Some mention must also be made of a
artificial food habit of sharks, namely the d
they inflict on longline-caught tuna.
workers have noted that damage is virtu
sent from the more northerly portions of
investigative area (Shomura and Otsu, 19
averages about 20 percent of the longlin
in equatorial waters (Murphy and Sh
1955; Iversen and Yoshida, 1956). It is
that shark damage to hooked tuna is ulti
limited by both shark abundance and the
bility of tuna, and that the interaction o
two factors coupled with the behavioral
teristics of sharks is what determines the
of the damage. For the purposes of the
study all species of longline-caught tuna

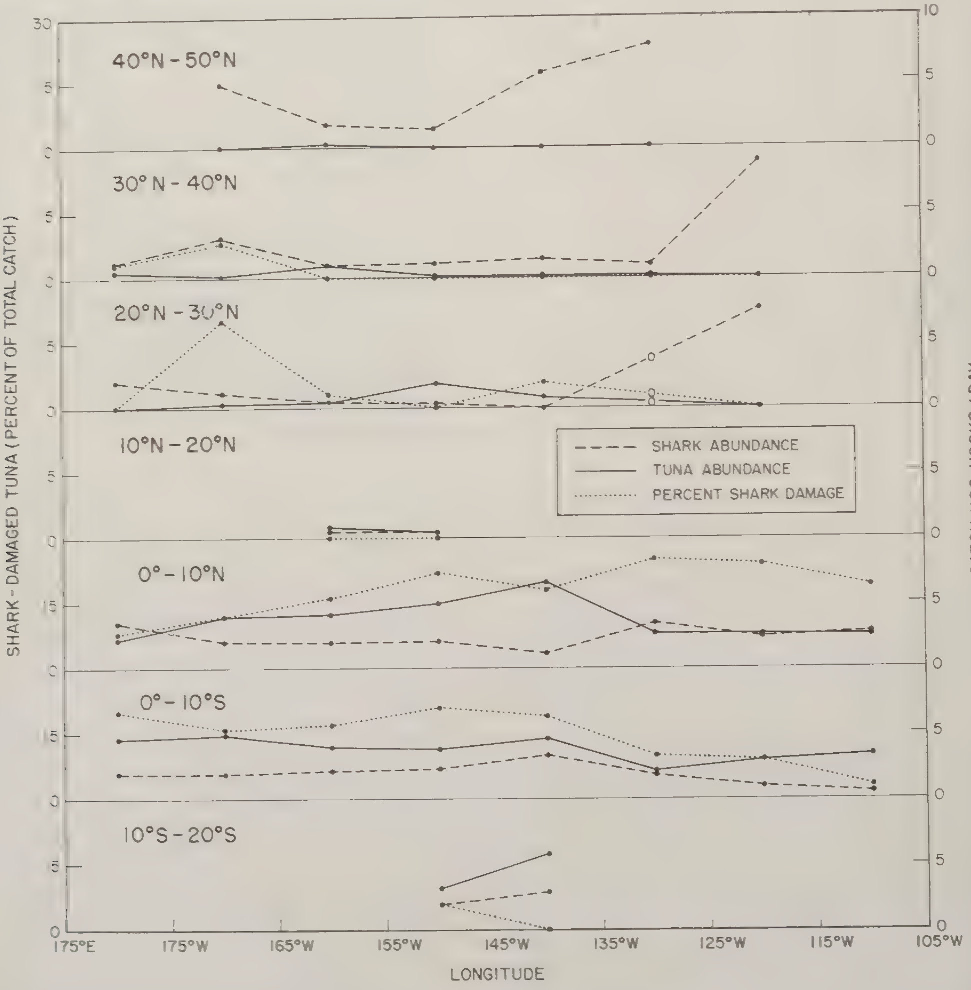
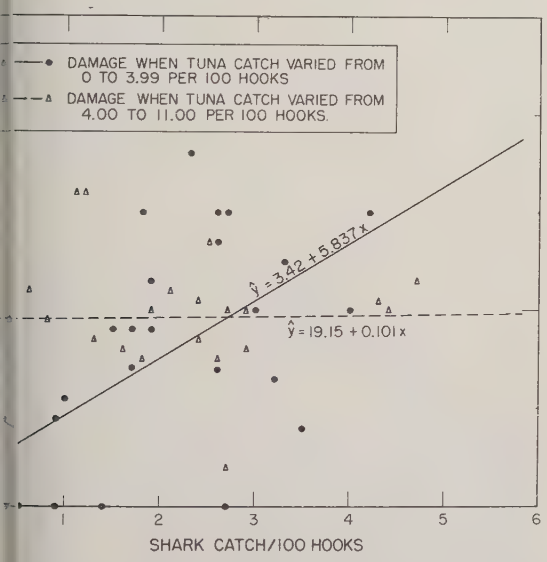


FIGURE 12.—Shark damage to tuna contrasted with shark and tuna abundance. 0=no sample.

nus macropterus, *Parathunnus sibi*, *Germo nga*, and *Katsuwonus pelamis*) are lumped una," and all shark species are combined.

rth of about 30° N. latitude POFI's long-tuna catch has been minimal, and shark ge affected only about 1 percent of it (fig. ıd Shomura and Otsu, 1956). Between 20° d 30° N. latitude tuna abundance increased as shark damage was only slight or moderate 12). The prominent peaking of shark ge between 20°–30° N. latitude and 165°–175° ngitude is an artifact caused by a very small e (1 damaged tuna out of 5 caught). In northern areas the abundant shark is the blue (fig. 3), and it would seem that this s is not particularly deleterious to the , other accounts to the contrary (c. f. w and Schroeder 1948: 286).

equatorial waters tuna abundance is equal greater than shark abundance (fig. 12), and damage is at its greatest here, frequently ing as much as 20 percent of the tuna catch. principal culprits in this region are the ip and silky sharks, with the bonito being of less importance (figs. 3 and 4, and numer- servations by POFI biologists). From the rial situation one might suppose a good positive correlation to exist between shark and tuna abundance, but this was not found by Iversen and Yoshida (1956). These authors found a strong relation between shark catch rate and shark damage on a monthly basis, but this breaks down, in part, when studied on a nonsecular basis. When tuna abundance is low there is a correlation ($r=0.573$) between shark abundance and shark damage (fig. 13), but when tuna abundance is high there is almost no relation between the two ($r=0.019$). A possible explanation of these phenomena is that an abundance of tuna probably indicates an abundance of forage organisms so that a large natural food supply (either tuna or forage) is available to the sharks. The sharks are well-fed and not interested in longline-caught fish. Conversely, a dearth of tuna and other forage animals would enhance the attractiveness of hooked tuna, and proportionally more of the catch would be eaten by sharks.



: 13.—Relation between shark damage of long- ht tuna and shark abundance. Based on catch of 8,797 tuna (of which 1,511 were damaged) sharks. All catches made between 10° N. and itude. When tuna catch low, $b=5.837$, $p<0.01$; a catch high, $b=0.101$, $p>0.5$.

SEXUAL SEGREGATION

Among sharks there appear to be two basic types of sexual segregation or tendency to school by sex. In behavioral segregation individuals school with others of similar size, thus sorting the sexes in the case of a dimorphic species such as *Squalus acanthias* (Ford 1921). In what has been called geographical segregation (Backus et al., 1956) the sexes school separately because of differences in habits. Geographical segregation has been found for *Scyliorhinus canicula* by Ford (op. cit.), for the soupfin (Ripley 1946), for *Galeorhinus australis* by Olsen (1954), the great blue (Bigelow and Schroeder, 1948), and the whitetip (Krefft 1954; Backus et al., 1956). These authors have related geographical segregation to season, region, depth, distance from land, and degree of sexual maturity, with the underlying causative factor generally being regarded as reproductive in nature. In two cases (Olsen 1954; Backus et al., 1956) the existence of definite breeding grounds has been mentioned.

The present data are scanty as to sex of the sharks caught, but nevertheless they indicate that both behavioral and geographical segregation may occur in the same species. This study is primarily restricted to the great blue because sex was not recorded for adequate numbers of the other species. An inherent fault in the data is that because of the length of the longline gear (7 to 10 miles in each set) a single day's catch may actually contain samples from several schools.

Table 4 illustrates the degree of unisexual predominance in the catches from 36 longline stations where sharks were sexed and at least 4 specimens of a species were taken. In the great blue shark the sex ratio varied from about 1:1 to a tremendous preponderance of one sex. The data on the whitetip and the silky were not so extensive and did not show this degree of variability.

Table 4.—*Instances of unisexual predominance in shark catches* [1]

Species and number of specimens examined	Frequency of occurrence of predominant sex (in percent)					
	50-59	60-69	70-79	80-89	90-99	100
Great blue (283)	6	3	5	3	2	10
Whitetip (29)		1	2	1		1
Silky (11)				1		1

[1] Units are number of stations showing predominance. The smallest station considered yielded 4 sharks of any one species.

In determining whether preponderance of either sex was of the behavioral or geographical type of segregation the great blue shark data were analyzed in several ways. When the percentage of males was plotted by latitude (fig. 14), males comprised a smaller proportion of the northern catch than they did of the southern. This difference is most striking when the unisexual catches are considered, but it is also apparent in mixed catches and the entire catch (unisexual and mixed data

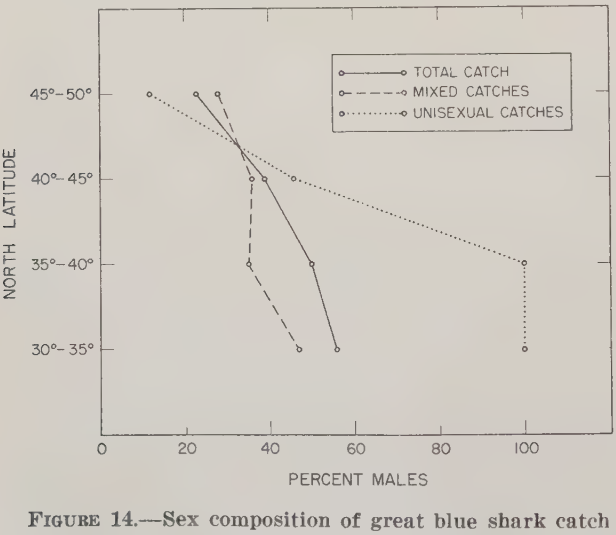


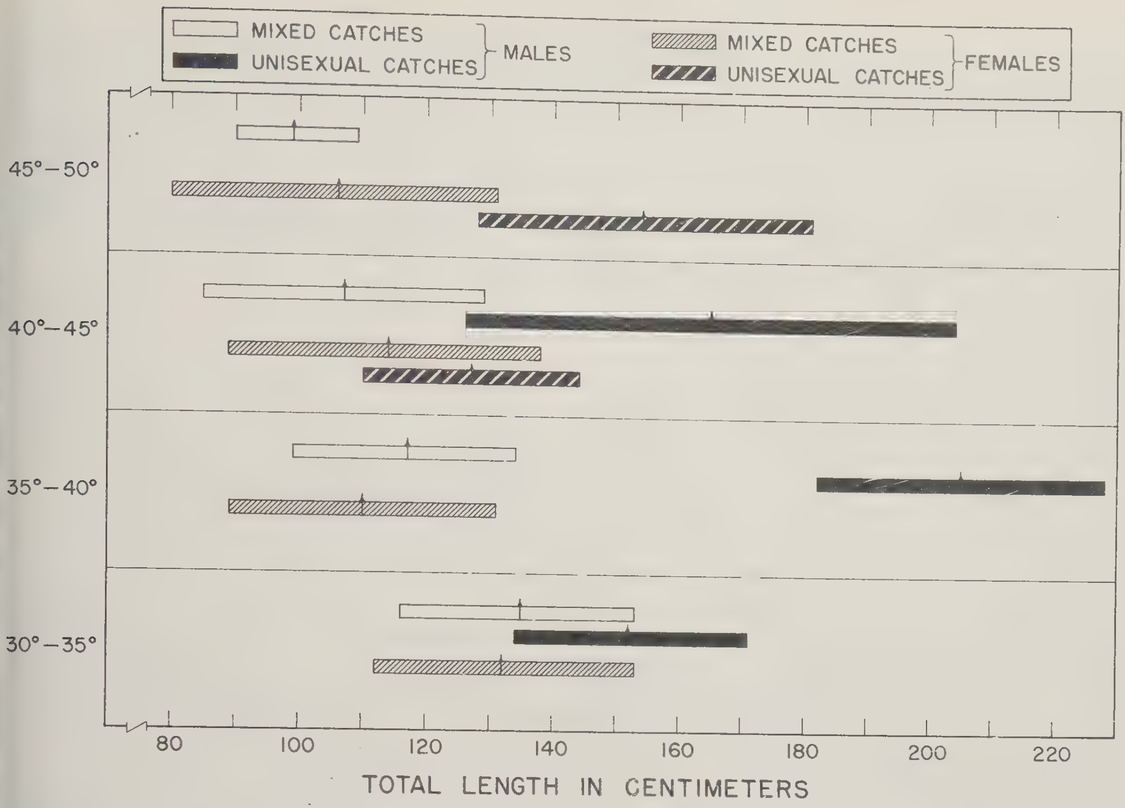
Figure 14.—Sex composition of great blue shark catch by latitude. Based on 255 records of which 184 were from mixed and 71 from unisexual catches.

pooled). There can be no doubt that lati variation in sex ratio represents geographi regation but the biological aspects of th nomenon are not so easily classified.

If the mean total length of great blues is by sex and latitude (fig. 15), it appears mixed catches (pooled from several station sexes are about the same size at any latitu the mean length decreases to the nort lengths of sharks from unisexual catc slightly to considerably greater than t mixed catches, but there is little relation the lengths of males and females. If our actually represent schools then it is not illo presume that unisexual schools are derive mixed schools by a behavioral size-sorting nism. Judging from the overlap betwe standard deviations of mixed and unisexua lengths, this mechanism becomes opera lengths between about 110 and 160 centimet is unlikely that segregation of such small has a direct reproductive significance, smallest gravid females known were from 214 cm. in length (Bigelow and Schroede and in this paper p. 354).

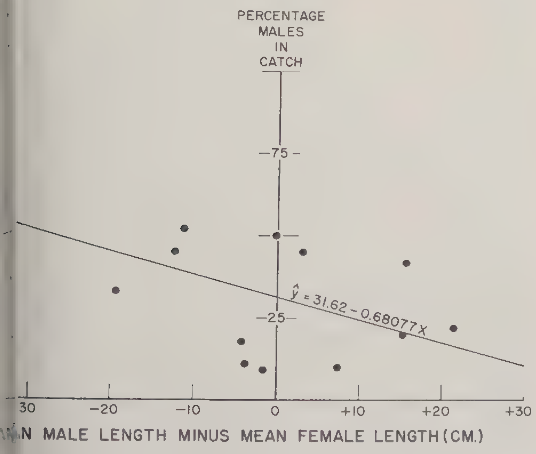
Because the causative agent for behavio regation is thought to be size dimorphism the sexes (Backus et al., 1956), it was reaso the difference between male and female le individual mixed catches should be relate sex ratio of the catch. This relation is s figure 16 which indicates that the greater difference between the sexes the greater parity in sex ratio. Where females are lar the males most of the catch is male, an males are larger than the females most of t is female. A similar situation obtains soupfin shark (Ripley 1946). Such a situa only poses the question of why large shark be of opposite sex from the rest of the sch it is also rather contrary to the principal behavioral schooling, that members of a be of like size. The regression in figure 1 nificant (p=0.02) only when the two point extreme left are included.

The available data are too few to for than an outline of the secular aspects of segregation. They are derived from a sa 255 great blues taken between 30° N. and latitude over a period of several years. mixed and unisexual catches were made



15.—Length composition of unisexual and mixed catches of great blue sharks at various latitudes. Vertical lines are means; blocks are one standard deviation on each side of mean.

er and autumn but only mixed catches were in the winter and spring. On a percentage mixed catches contained the following pro- ns of males: spring 36 percent, summer 33 t, autumn 22 percent, and winter 47 percent. The autumnal disparity in sex ratio is also of interest in that the two unisexual catches made in that season were composed of males. The low male ratio in summer mixed catches is similarly reflected in the unisexual data, for here only 2 all-male (versus 4 all-female) catches were made. From these sketchy data it appears that the great blue catch is composed of about equal numbers of both sexes in the winter, and that females gain predominance in the spring. Unisexual schools form during the summer and autumn and probably reassemble as mixed schools in the winter. The data are too few to present a latitudinal picture of these changes.



16.—Relation between sex and size composition dual mixed great blue shark catches. Based on ts taken in catches containing from 5 to 24 indi- Regression line fitted by method of least squares.

When the mean lengths of great blues are plotted by sex and season (fig. 17), it is evident that autumn is not only the period of greatest disparity in sex ratio but is also the time of greatest length difference between the sexes. Unfortunately, the data were necessarily derived from pooled mixed and unisexual catch records and are thus rather unreliable (in the case of unisexual records there is no particular reason for

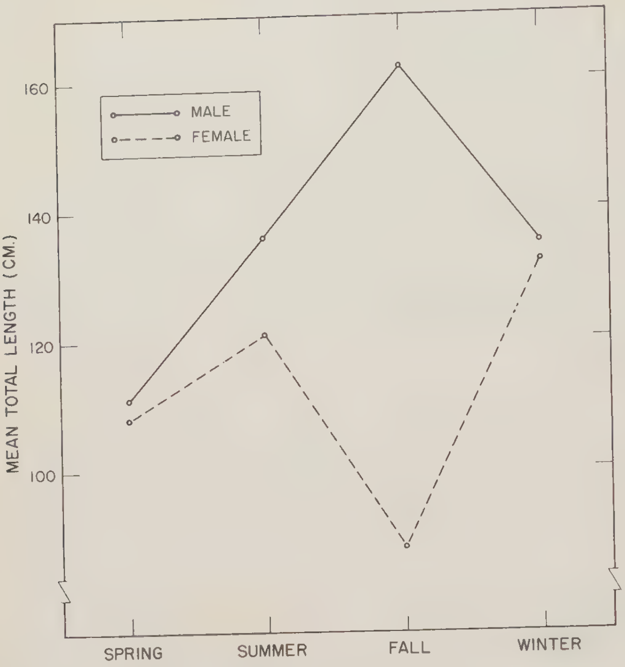


FIGURE 17.—Mean total length of great blue sharks by sex and season. Based upon 112 males and 143 females from mixed and unisexual catches taken between 30° N. and 50° N. latitude.

one school to resemble another in its length composition). The increase in mean length over the spring-to-fall interval probably reflects an availability fluctuation more strongly than growth.

REPRODUCTION

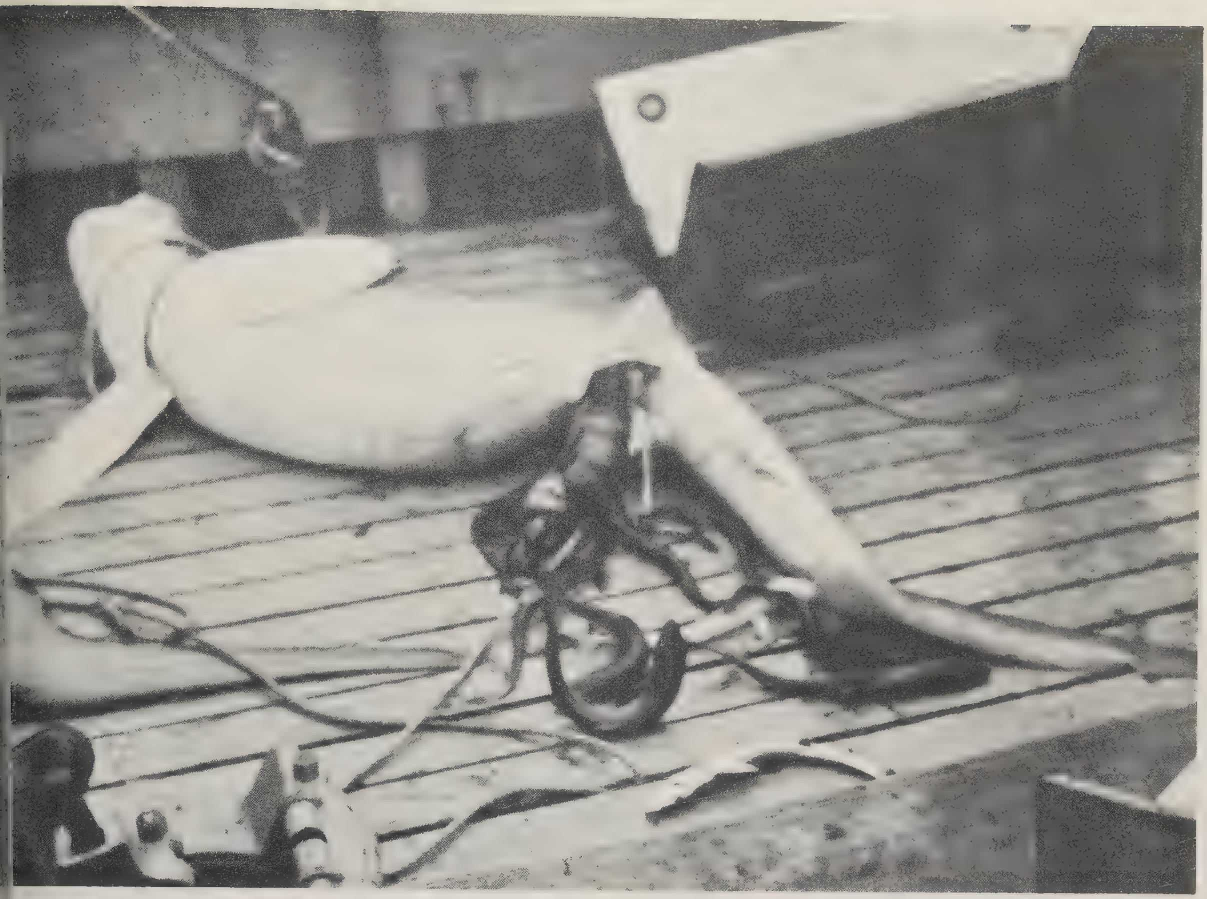
The available data on reproduction in the female are based on observations on the following: 18 great blues, 19 silkies, 32 whitetips, and 4 threshers (2 *A. pelagicus*, 1 *A. vulpinus*, 1 *A. superciliosus*). All of these except 6 great blues and 1 whitetip were taken in equatorial waters, with most specimens coming from the Line Islands area. Although the data are meager they are presented because of the general lack of knowledge of the reproductive habits of pelagic sharks.

Of the 12 great blue sharks from the equatorial Pacific the smallest gravid female measured 214 cm. and the largest 244 cm. Nongravid females from this region ranged from 188 to 243 cm. in total length. Embryos were found during February, March, May, August, October, and December, with the largest fetuses (22–28 cm.) occurring in March and May. Nongravid females as large or larger than the pregnant ones were encountered from January through Augus number of embryos per female ranged fro 38, and in 1 litter of 18 their distribution on the left side and 10 on the right. The no apparent correlation between embryo si time of year.

The 6 nonequatorial great blue female taken between 24° N. and 35° N. latitude 4 gravid specimens ranged from 208 to 247 total length and contained from 23 to al embryos, the distribution of which was bi (16 on the left side and 17 on the right in 1 men). All 6 females were taken in Janua February and here again there was no r between embryo size and time of year. C male obtained in February gave birth to b 30 and 40 pups on deck (fig. 18), and thes the largest great blue embryos taken, sugg that they were very near term. Further co ing this conclusion is the fact that their range (34–48 cm.) approximates the foot- half length of the smallest longline-caugh blues. Also, the pups were very active a and appeared ready to fend for themselve emerged tail first.

All 19 female silky sharks were taken fr equatorial region, and of these 12 were gra 7 not. Both gravid and nongravid femal taken throughout the year, the range i length of the former being 213 to 236 c of the latter, 186 to 218 cm. The number of observed varied from 2 to 11, with a mean 6.5 per female. The total length was recor 32 embryos and ranged from 37 to 66 c upper extreme suggesting that the pups a sizeable when born. There again appeare no relation between embryo size and time Uterine distribution of embryos was recor 2 females, one of which had 4 embryos on e the other having 2 on the left and 5 on th The single litter sexed contained 2 male a male embryos.

Only 3 of the 32 female whitetips examin tained embryos, these 3 being equatorial mens. A 210-cm. specimen was taken in Ap contained 6 fetuses from 36 to 40 cm. i length, a 196-cm. female obtained in May 20- to 28-cm. embryos, and a 195-cm. femal in December contained 7 averaging 18 cm. length. These fragmentary data suggest different developmental picture from that



18.—Female great blue shark giving birth to young on deck of the *John R. Manning*. Nine young can be seen on deck while a tenth, still enveloped in its embryonic membranes, is just emerging.

s et al. (1956) for the whitetip of the Gulf xico and the West Indies, as the central embryos were rather small at all times of r. One Hawaiian and 28 equatorial white-nales contained no young. These infertile were taken throughout the year and ranged th from 99 to 246 cm.; about one-fourth group were as large or larger than the grav- ales.

regard to thresher sharks, the single fe- *lopias vulpinus* examined was captured on 1954, just to the west of Christmas Island group). This thresher measured 315 cm. length and contained 2 fetuses, one of vas 114 cm. in total length. Also present number of eggs about 0.7 cm. in diameter. nales of the rather uncommon *A. pelagicus* amined, the larger (893 cm. total length) ken on April 7, 1955, off Fanning Island roup), and the smaller (167 cm.) on May 4, 1953, at about 9° N. latitude and 150° W. longitude. The larger female contained the apparently typical number of 2 embryos (see Nakamura 1935), and the smaller one was not gravid. On June 7, 1954, a nongravid female of *A. superciliosus* was taken near Christmas Island. Its total length was 328 cm.

MORPHOMETRY AND TAXONOMY

In the early part of the shark investigation morphometric data were recorded for a number of specimens of each species. In order to make these data comparable to those of other investigators, measurements were standardized with those given by Bigelow and Schroeder (1948). Figure 19 depicts the methods used for measuring certain characters; other measurements follow. Eye diameter — greatest horizontal diameter; labial furrow length—length of outer labial furrow; gill slit height—height of gill opening when

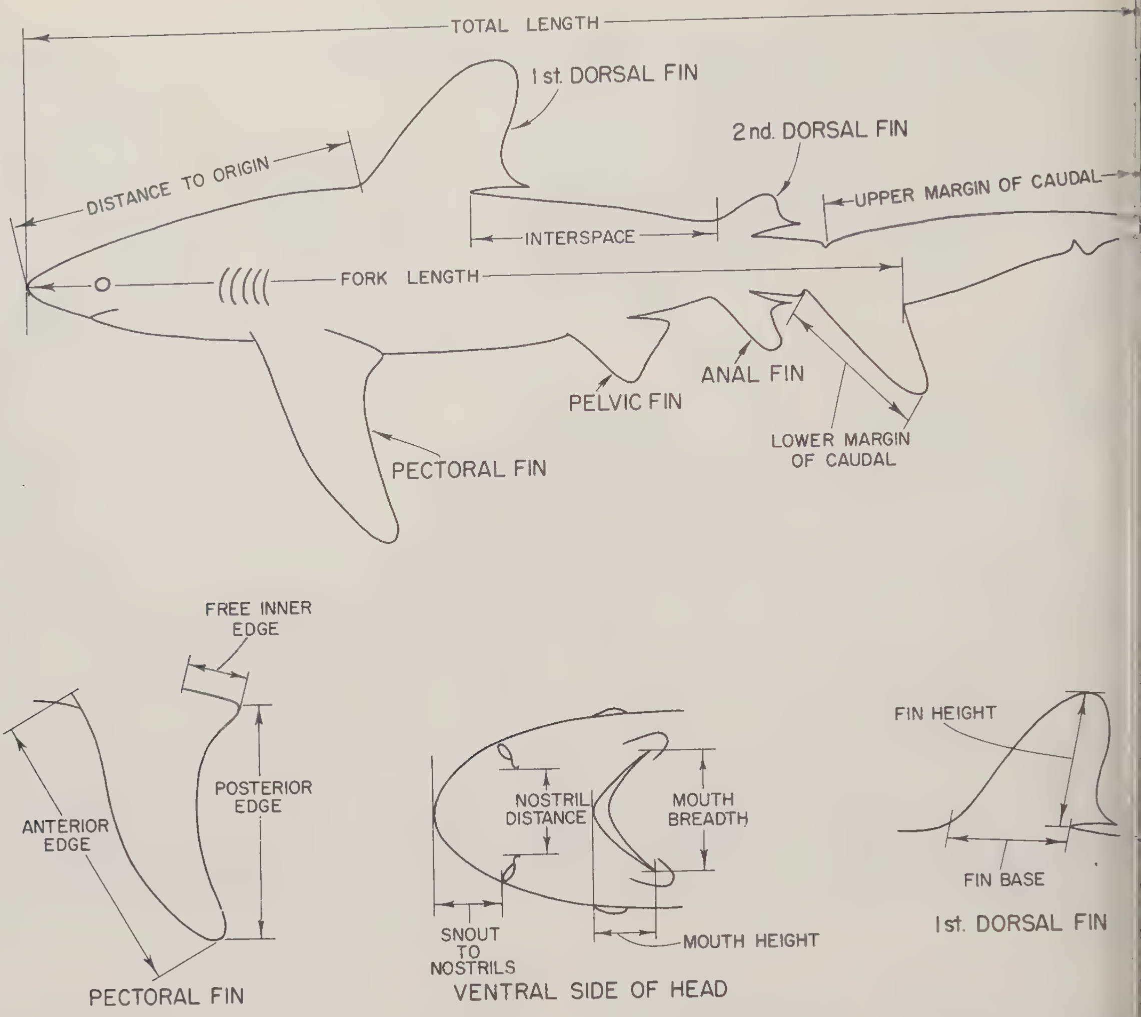

TOTAL LENGTH
1st. DORSAL FIN
2nd. DORSAL FIN
DISTANCE TO ORIGIN
UPPER MARGIN OF CAUDAL
INTERSPACE
FORK LENGTH
ANAL FIN
PELVIC FIN
LOWER MARGIN OF CAUDAL
PECTORAL FIN
FREE INNER EDGE
POSTERIOR EDGE
ANTERIOR EDGE
PECTORAL FIN
NOSTRIL DISTANCE
MOUTH BREADTH
SNOUT TO NOSTRILS
MOUTH HEIGHT
VENTRAL SIDE OF HEAD
FIN HEIGHT
FIN BASE
1st. DORSAL FIN

FIGURE 19.—Method of measuring sharks. All distances are straight lines between perpendiculars, with fish
belly when possible.

stretched just enough to prevent buckling of anterior edge; trunk breadth and height—maximum breadth and height at pectoral origin; lower margin of caudal—distance from rear edge of ventral precaudal pit to tip of lower caudal lobe; free clasper-distance from point where clasper leaves anal fin (lateral side) to tip of clasper.

Table 5 summarizes the morphometric data obtained in this study. For the common species the mean and the range are given for each character considered, although the range was not necessarily derived from individuals of maximal and minimal length. The original data were tabulated by sex, but with a very few exceptions overlapping was complete or nearly so, and it did not appear necessary to segregate the final data in this manner.

The volume of morphometric data avail
whitetip, silky, and great blue sharks ma
sible a comparison between the central Pac
other forms. Morphometric data for
specimens were obtained from Bigelo
Schroeder's descriptions (1948) even thoug
were derived from only a few specimens.
three species it appears that in the Pacifi
mens the distance between the snout and
except the anal is greater than in Atlant
terial, and also that the second dorsal, th
and the upper caudal lobe are smaller in
cific. In Pacific whitetips the lower caud
and the various pectoral fin measureme
relatively greater than in the Atlantic,
in Pacific silkies and great blues these str

TABLE 5.—*Shark morphometrics*

[Values expressed as hundredths of total length. Columns indicating range express the range for each character, and not the measurements of the largest and the smallest shark. See pp. 355–56 for measurement methods]

Item	Whitetip (8 males, 8 females)			*P. insularum*[1]	Silky (7 males, 5 females)			Great blue (17 males, 5 females)			Bonito (11 males, 2 females)			Mackerel (1 male, 1 female)	Thresher (*A. pelagicus*) (1 male, 2 female)	Thresher (*A. superciliosus*) (1 female)	Thresher (*A. vulpinus*) (1 female)	Hammerhead (*S. zygaena*) (1 male)	Hammerhead (*S. lewini*) (1 male)	Blacktip (1 male, 1?)
	Smallest	Largest	Mean	Type	Smallest	Largest	Mean	Smallest	Largest	Mean	Smallest	Largest	Mean	Mean	Mean					Mean
Total length (cm.)	72.0	243.1	116.0	213.0	87.7	227.0	192.7	121.7	304.5	234.3	125.1	257.9	205.9	96.0	290.2	327.7	317.0	266.3	301.8	143.2
Fork length	77.3	83.5	80.0		78.5	83.6	80.7	80.1	83.2	81.9	86.8	92.2	88.0	86.2	53.6	57.4	52.5	77.8	80.4	78.6
Snout—1 D	31.3	34.2	32.6	33.3	32.4	35.0	34.1	36.2	39.8	37.9	35.6	38.6	37.3	34.4	25.6	30.4	24.6	27.3	28.2	33.4
Snout—2 D	61.9	65.3	63.2	65.3	63.9	66.7	64.9	62.4	67.2	64.7	69.5	73.2	70.5	67.8	43.0	46.1	41.3	63.5	64.1	63.8
Snout—upper C	71.3	76.6	72.5	74.2	73.0	77.8	74.0	74.0	76.4	75.5	77.9	80.1	79.3	76.6	48.1	51.1	45.9	73.1	74.2	75.0
Snout pectoral	20.9	24.2	22.5	22.5	20.7	23.7	22.0	19.8	25.0	22.1	23.5	28.0	26.3	29.8	14.4	15.8	14.6	19.8	19.6	20.5
Snout—pelvic	49.5	54.5	51.8		47.6	52.1	49.5	48.0	54.3	50.8	53.9	57.6	55.8	54.8	36.7	38.0	34.8	45.4	46.4	48.7
Snout—anal	61.8	66.2	63.8		61.8	65.8	64.0	61.4	67.5	64.0	70.2	74.1	71.7	67.6	44.6	48.9	43.7	59.8	61.4	63.6
Interspace 1 & 2 D	19.4	22.7	21.1	22.1	22.5	25.3	23.9	19.0	26.4	20.9	24.6	27.0	25.7	25.9	16.7	9.5	12.8		28.1	23.8
Interspace 2 D & C	5.4	7.9	6.4	6.0	6.6	7.9	7.1	7.1	10.0	7.7	7.7	9.0	8.4	7.8	4.1	4.6	4.5	8.5	8.2	7.2
Interspace A & C	3.9	5.1	4.5	3.8	5.3	7.3	6.5	6.9	10.0	7.4	7.2	9.3	7.8	7.8	3.0	2.7	3.1	7.8	7.8	6.5
Origin Pect.—pelvic	28.1	35.2	30.6		26.2	29.9	28.1	26.1	32.9	29.0	22.8	32.0	29.6	26.6	22.7	23.3	20.8	25.7	27.2	27.8
Origin Pelvic—anal	12.1	14.3	13.0		13.6	17.2	15.3	12.1	15.3	13.5	15.6	17.8	16.9	15.1	8.8	11.0	9.5	14.6	14.3	15.9
Snout—nostrils	2.5	3.4	3.0		3.4	4.7	3.9	3.4	4.9	4.2	4.3	5.4	4.8	5.2	2.8	3.1	2.8		4.1	3.2
Snout—mouth	6.1	7.3	6.8		6.5	8.4	7.1	7.9	10.4	8.6	6.2	7.2	6.6	6.7	4.2	4.5	4.1	4.5	4.1	6.4
Mouth breadth	8.8	10.1	9.3		7.4	8.9	8.4	3.0	7.7	6.4	6.4	7.9	7.1	9.5	3.4	4.2	3.6	7.4	7.2	8.8
Mouth height	4.1	6.1	4.9		4.1	6.0	4.9	3.0	4.9	3.8	5.4	6.9	6.1	5.6	2.3	2.4	2.0	3.4	4.7	5.4
Eye diameter	.9	1.8	1.3		.9	1.9	1.3	1.0	2.0	1.5	1.5	2.1	1.7	2.2	1.4	2.0	1.4	1.2	1.1	1.4
Nostril distance	5.6	6.0	5.8		5.1	5.8	5.3	3.3	3.8	3.5	3.3	4.6	3.7	3.8	1.2	1.5	1.2	20.5	20.7	5.4
Labial furrow length	0	2.2	.8		.4	1.1	.6	0	1.4	.6	0	3.7	2.1	1.6	1.9	.9	.6		.3	.6
Height gill slit 1	2.9	4.8	3.3	3.5	2.6	3.5	3.1	2.0	3.3	2.5	6.5	8.2	7.4	8.0	2.4	2.5	1.9	3.0	3.0	2.8
Height gill slit 2	3.4	4.7	3.8	3.8	2.9	4.0	3.3	2.1	3.7	2.9	6.5	8.2	7.3	7.5	2.6	2.7	2.1	3.2	3.2	3.1
Height gill slit 3	3.3	4.9	4.1	4.1	2.9	4.4	3.5	2.3	3.7	2.9	6.3	8.0	7.2	7.5	2.7	2.9	2.2	3.2	3.4	3.2
Height gill slit 4	2.8	4.6	3.7	3.8	2.6	3.7	3.1	2.0	3.4	2.7	6.4	7.9	7.1	7.4	2.4	2.7	2.1	2.9	3.4	2.8
Height gill slit 5	1.9	3.8	2.7	2.7	1.9	3.0	2.4	1.3	2.7	1.9	6.7	8.1	7.4	6.8	1.7	2.4	1.8	2.0	2.4	2.2
Trunk breadth	12.0	14.6	13.1		11.2	13.1	12.1	9.0	12.1	10.4	10.9	14.4	12.4	16.2	7.1	7.1	7.9	9.0	10.3	12.0
Trunk height	7.8	14.8	12.4	12.1	10.5	12.2	11.4	8.5	12.6	10.6	11.8	15.3	13.7	18.3	10.3	9.2	9.3	11.6	11.4	11.6
Vertical height 1 D	10.0	14.4	12.9		7.5	9.4	8.5	6.2	9.3	7.6	8.6	10.1	9.6	9.8	6.2	7.5	6.6	12.4	12.6	9.0
Base 1 D	10.0	11.3	10.7	9.8	7.6	9.0	8.4	6.5	7.8	7.0	8.2	9.4	8.9	9.4	5.3	6.7	5.2	10.2	9.1	8.6
Vertical height 2 D	2.9	4.2	3.4		1.8	2.5	2.1	2.1	3.1	2.7	.9	2.0	1.4	1.7	.7	.6	.6	2.1	2.3	3.1
Base 2 D	3.0	3.9	3.4	3.0	2.1	2.8	2.4	2.6	3.8	3.5	.8	1.1	1.0	1.4	.6	.8	.6	2.5	2.3	3.6
Vertical height anal	3.3	6.0	4.3		2.3	4.0	3.2	2.5	4.3	3.4	1.0	2.2	1.6	2.0	1.1	1.3	.9	2.9	2.5	3.7
Base anal	3.5	4.7	3.9	4.2	2.8	3.3	3.0	3.1	4.3	3.7	.8	1.4	1.1	1.7	1.0	1.5	.8	3.8	4.0	3.9
Upper margin C	23.4	28.7	27.5	27.9	22.2	27.0	26.0	23.6	26.0	24.5	19.9	22.1	20.7	23.4	51.9	48.9	54.1	26.9	25.8	25.0
Lower margin C	12.5	14.7	14.0	14.1	11.4	13.5	12.6	11.1	14.0	12.2	15.2	17.4	16.2	16.6	7.0		6.6	12.7	12.8	11.6
Pect. ant. edge	21.5	26.1	23.8	18.3?	16.2	20.9	19.3	19.1	23.3	21.3	17.0	25.1	19.6	17.0	17.7	20.1	18.6	14.0	14.1	17.4
Pect. free inner edge	5.1	6.7	5.8	6.6	3.3	4.9	4.4	3.1	4.9	3.9	3.9	5.7	4.5	4.9	1.5	3.0	1.5	2.9	3.1	4.9
Pect. post. edge	19.1	23.4	22.4	17.4?	12.7	18.2	16.7	15.6	20.3	18.6	13.9	22.7	16.8	13.8	17.0	19.7	19.0	11.6	11.7	14.6
Free clasper	2.1	11.2	6.9		2.3	14.2	7.0	2.1	9.6	5.6	2.0	11.2	8.1	4.0				4.6	4.5	

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[1] Data from Snyder (1904).

are generally smaller than in their Atlantic counterparts. The gill slit heights of Pacific specimens compare with the Atlantic forms as follows: Pacific great blues, larger; whitetips, smaller; silkies, about the same size.

The other species listed in table 5 either lacked Atlantic counterparts or were represented by an inadequate size range for comparative purposes. The present data for *Alopias pelagicus* are derived from a 354.3-cm. male and 2 females of 166.8 and 349.5 cm., total length. The mean values presented in table 5 agree fairly well with the measurements given by Nakamura (1935) for adult specimens from Taiwan, and where the means do not agree the range in our values (not given here) overlaps Nakamura's figures. Finally, our data for mackerel sharks (*Lamna ditropis*) are based on small specimens (95.8 and 96.1 cm., total length) and do not appear to be comparable to those of the Atlantic mackerel shark (*L. nasus*). For identification purposes it is of interest that our small *ditropis* have a basal lateral denticle on the teeth (as shown by Roedel and Ripley, 1950) but have relatively long snouts. The distance from the snout tip to the anterior edge of the eye is only slightly less than half the distance between the posterior edge of the eye and the first gill slit.

Another identification problem concerns the name to be used for the Pacific whitetip. Our data and those of other authors (Hubbs 1951, Krefft 1954) agree very well with descriptions of the Atlantic whitetip (*Pterolamiops longimanus*) given by Bigelow and Schroeder (1948) and Springer (1950), but there is a possibility that *P. insularum*, which was described from Oahu by Snyder (1904), actually represents the species under discussion. Snyder's measurements of the holotype have been converted to percentage values and listed in table 5 for comparative purposes, but these figures do not solve the problem. The principal differences between *insularum* and other Pacific specimens are in the morphology of the pectoral fin, with this structure being relatively small in *insularum*. This could be caused by either the type being an aberrant specimen, *insularum* being a distinct species, or doubtfully, by much different methods of measurement. It would seem that *longimanus* is the name to be applied to the whitetip reported on here unless future work reveals it to differ from the Atlantic form in some manner not considered at this time.

The length-weight relationships obtainin
the whitetip, silky, bonito, and great blue sh
are shown in figure 20. The data indicate tha
whitetip, silky, and bonito sharks have n
identical weights for any given length, but
the great blue is a lighter fish. In the ori
plots the data were segregated by sex, and i

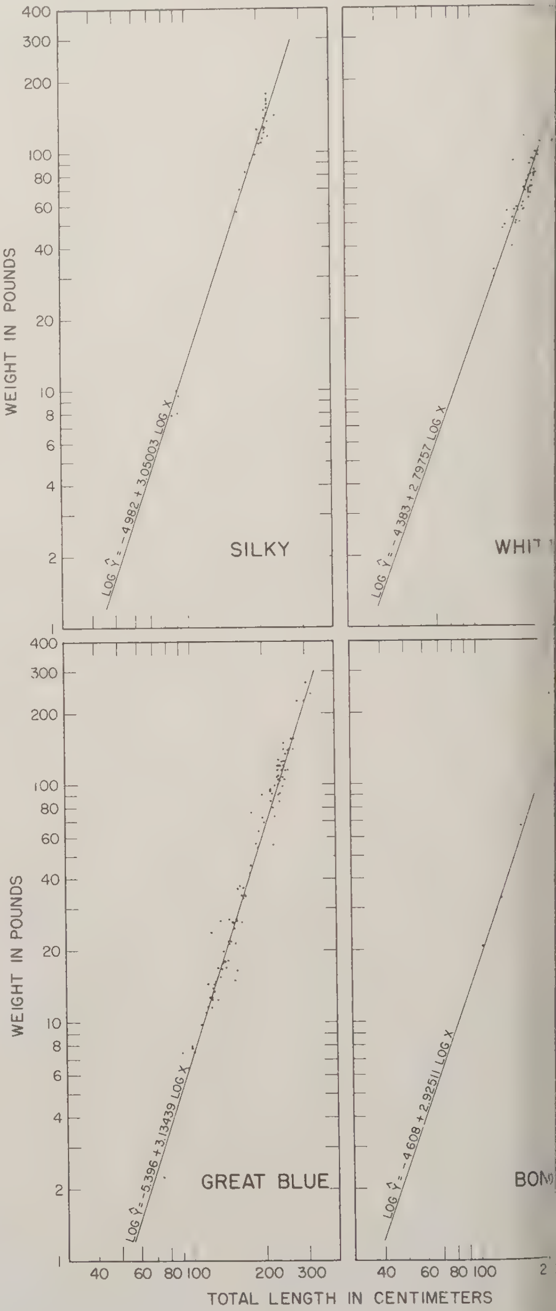

FIGURE 20.—Length-weight relationships for w
silky, bonito, and great blue sharks.

t blue and whitetip sharks females were slight-
avier than males. This is to be expected, for
of the specimens were known to be gravid.
original data were also broken down by locale,
no differences in length-weight of the sharks
noticeable between those from the Line Is-
, the Phoenix Islands, various isolated
ic positions, and the west coast of Central
ica.

SUMMARY

This report is based on the catch records of
uises made in the area between 50° N. and
. latitude and 110° W. and 175° E. longitude
g 1952–55. Of 6,118 sharks captured on
ne gear, there were 2,512 great blues, 2,176
s, 1,187 whitetips, and 243 belonging to 9
vely uncommon species.

The 12 shark species taken show considerable
ences in range and abundance. The great
nd the bonito were wide ranging, the former
abundant, the latter uncommon; the white-
d silky were abundant warm-water forms
he whitetip's range lying roughly between
. and 20° S. latitude and the silky's more
vly equatorial; the mackerel shark was un-
n and subarctic; the 3 species of thresher
were uncommon and equatorial, but may
roader ranges; and the soupfin, hammerhead
cies), and blacktip were all rare in POFI's
.

he great blue shark appeared to make pro-
d northern migrations, probably reproduc-
nature, during the warmer parts of the
Migrations followed the advance and re-
f a transition zone between two major ocean
s. Whitetip and silky sharks were nearly
nly abundant throughout the year. Their
rtherly records were obtained in summer.
hen the vertical distribution of sharks is
d by relative depth of hook-of-capture, the
n great blues are found to be taken prin-
by shallow hooks and the southern ones
hooks. The species apparently favors
tures between 45° and 69° F. Perhaps also
ing the great blue's vertical distribution
l latitudes is the larger amount of food
on the surface. Bonito and thresher
were broadly eurythermal, whereas the
l appeared to be more nearly stenothermal. The whitetip was surface-dwelling north of the Equator and bathypelagic to the south; the silky shark was uniformly distributed at all hook depths.

5. In the equatorial region the great blue and whitetip sharks were more abundant during warm years than cold, but the silky shark appeared to be the opposite. This difference in abundance may represent a behavioral interaction rather than a temperature-induced phenomenon.

6. In the Equatorial Countercurrent (5° N. to 10° N.) overall shark abundance decreased from east to west between 110° W. and 175° E. longitude, paralleling the situation found for zooplankton volumes. Between 5° N. latitude and the Equator, total shark abundance was minimal at about 140°–150° W. longitude and higher on either side, whereas between the Equator and 10° S. latitude just the reverse occurred. The former situation is similar to that found for inorganic phosphate, the latter similar to that for tuna and zooplankton. The trophic relations obtaining in these situations remain to be demonstrated.

7. The silky and thresher sharks were more abundant near land, whereas the whitetip and great blue were more strictly oceanic, and declined in abundance near islands. There is some evidence for biotic interaction (food competition) between the silky and whitetip sharks in areas intermediate between the neritic and oceanic provinces.

8. All sharks examined were found to subsist principally on small fish and squid, and occasionally to ingest inedible objects. Some species probably capture live tuna on occasion.

9. In northern waters shark damage to hooked tuna averaged only about one percent of the catch, and the abundant shark there, the great blue, is regarded as rather harmless in this respect. In the equatorial area, damage amounted to about 20 percent, and was largely attributed to the silky and whitetip sharks. In this region damage was related to shark abundance only when tuna abundance was low. Shark and tuna abundance themselves were not correlated.

10. Several species of sharks tend to school by sex, and segregation of this type is known as behavioral when caused by size dimorphism between the sexes, or geographical when caused by other factors. The great blue, whitetip, and silky sharks

exhibit sexual segregation to the extent that catches may show a 1 : 1 sex ratio or may consist of solely one sex. For the great blue shark, males comprised an increasingly smaller proportion of the catch to the north, and the mean size of both sexes in mixed catches steadily decreased to the north, with both being about the same length at any latitude. In unisexual catches both sexes were larger than in mixed catches. In individual catches containing both sexes there was a tendency for a few large females to occur with numerous small males or vice versa. On a secular basis it appears that in the winter both sexes occur together in about the same ratio, females begin predominating in the spring, unisexual schools form in the summer and autumn, and reassembly of mixed schools takes place in the winter.

11. Gravid females of the great blue shark measuring from 208 to 247 cm. (total length) were taken throughout the year along with nongravid specimens of the same size range. The largest embryos were found in March and May but no pupping season could be demonstrated. The number of embryos ranged from 4 to about 40, with large pups (34 to 48 cm.) being of the same size as numerous longline-caught specimens. Gravid females of the silky shark, ranging from 213 to 236 cm., were taken throughout the year and were similar in size to nongravid specimens. The number of fetuses per female ranged from 4 to 11.

12. Detailed morphometrics were obtained from 16 whitetip, 12 silky, 22 great blue, 13 bonito, 2 mackerel, 5 thresher, 2 hammerhead, and 2 blacktip sharks. Pacific whitetip, silky, and great blue sharks differed from their Atlantic counterparts in having a greater distance between the snout and all fins except the anal, and also in having smaller anal, second dorsal, and upper caudal fins. Minor differences are shown for other characters, but none of these indicates a lack of conspecificity between the two oceans. The whitetip reported on is termed *Pterolamiops longimanus* on the basis of marked differences between it and the Hawaiian *P. insularum.*

13. Whitetip, silky, and bonito sharks have nearly identical length-weight relationships but the great blue is a lighter, more slender fish. No geographical differences were noted in length-weight.

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NOTES

Sexual Dimorphism in the Labrid Fish Genus *Gomphosus*[1]

During an examination of the viscera of arshallese fishes the writers' attention was rawn to the fact that all of our specimens of *omphosus varius* in which the sex could be de- rmined were females, and that all specimens *G. tricolor* were males. Suspecting the possibil- y of sexual dimorphism, we collected addi- onal material, so that this study of *Gomphosus* timately included 56 specimens from Eniwe- k, 4 from Bikini, 3 from Arno (all atolls in the arshall Islands), and 15 from Oahu and Kauai the Hawaiian Islands. Seven Marshallese and Hawaiian specimens were *tricolor*, according to rious descriptions; 14 Marshallese specimens ere the distinctively marked juveniles of *varius*; d the remaining 54 were typical *varius*. Eight the 10 *tricolor* proved to be males, one was composed internally, and another was too mature to be sexed. Sex could not be deter- ined for any of the 14 juvenile *varius*, but 39 the larger specimens were females in various ges of maturity while 15 were immature and uld not be sexed.

The major taxonomic difference between *tri- or* and *varius* is color and color pattern. In e *tricolor* is a rich blue-green with a vertical llow-green bar across the trunk near the ctoral insertion. Its head and caudal fin tend be rather more bluish than the rest of the dy, and in large specimens the caudal fin is mewhat lunate. *G. varius* is somberly colored comparison, being plain black posteriorly and amy white to light brown anteriorly, each ero-dorsal scale having a dark spot at its se. The breast and cheeks are white or cream, snout tip is reddish, and a narrow black pe runs the length of the head at the level the pupil. Small juveniles of *varius* are bright low-green dorsally, plain white laterally and trally, and have a pair of lengthwise black stripes from the snout tip to the caudal base. They also differ from larger specimens in that they either lack or are just developing the elongate snout characteristic of the genus. Jordan and Evermann (1905. *U. S. Fish Comm., Bul.* 23: pl. 36) present a color plate of *tricolor* and in the same work (*op. cit.*, p. 289, fig. 125) a black and white drawing of *varius*.

In size, our *tricolor* range from 104 to 166 mm. in standard length, whereas typical *varius* range from 38 to 134 mm. From about 30 to 40 mm. the *varius* and juvenile color patterns intergrade, our largest true juvenile measuring 36 mm. and the smallest 23 mm. Similarly, but on the other end of the scale, our smaller *tricolor* show unmistakable vestiges of a *varius* color pattern, the persistent elements being the basal dark spots on the anterior trunk scales. These spots are more obvious in preserved material than in fresh specimens but some indication of their presence occurs on all *tricolor* examined. The largest *tricolor* have slightly lunate caudal fins, a condition often appearing with age or sex in fishes, and here it is apparently restricted to the male.

Meristic data are the same for the two forms, based on 10 *tricolor* and 19 *varius*. Dorsal rays are VIII, 13; anal rays III, 11 (the first spine is imbedded) although one *tricolor* had only 10 anal rays; pectoral rays are 16, including the short bony splint at the top of the fin, with an occasional specimen having 15 or 17 rays; and lateral line scales are 27. The gill arches are C-shaped and not readily divisible into upper and lower limbs. Gill rakers totalled 24 for the first arch in the two *varius* and two *tricolor* examined for this feature.

The above facts point to the hypothesis that in the Hawaiian and Marshall Islands, at least, the species of *Gomphosus* hitherto regarded as *tricolor* and *varius* are in reality the two sexes of the same species. Apparently *tricolor* represents mature and nearly mature males while *varius* includes all females and probably also young males (even though no recognizable males were found with typical *varius* coloration). Mature males are somewhat larger than the largest females and also tend to have lunate caudal fins. More than likely an histological examination of the gonads of small "*varius*" would show both sexes displaying the *varius* or juvenile color pattern.

---

[1] This paper is Contribution No. 86, Hawaii Marine oratory, in cooperation with the Department of logy and Entomology, University of Hawaii. The or author was a member of the staff of Duke Uni- ity at the time the work was done. Manuscript ived August 7, 1956.

Marked sexual dimorphism, expressed as coloration differences, is not unusual among the labroid fishes. Longley (Longley and Hildebrand, 1941. Papers from Tortugas Lab. 34: 196–198) showed that in *Thalassoma bifasciatum* only adult males attain the *bifasciatum* color pattern, whereas females and young males exhibit a coloration so characteristic that they were long called *T. nitidum*. Recently Randall (1955. *Copeia* 3: 237) has demonstrated that *Stethojulis renardi* is merely the adult male of *S. strigiventer*, and Brock and Yamaguchi (1954. *Copeia* 2: 154–155) have shown that *Scarus ahula* is the female of *S. perspicillatus*. The latter authors contrast the bright blue, green, and yellow pattern of male *perspicillatus* with the rather drab pattern of the female, a situation quite similar to that obtaining in *Gomphosus*.

One line of evidence which seems to cast doubt on our hypothesis that *tricolor* and *varius* are dimorphic forms of the same species is their pattern of distribution and relative abundance. In the 2-to 35-foot depth range sampled for this study *tricolor* occurred mostly in deeper water and was uncommon even there. *G. varius*, on the other hand, seemed to be uniformly distributed throughout this range and was common to abundant. Every rotenone or sight-observation station yielding *tricolor* also produced *varius*, but the reverse was certainly not true. Disjunctive distributions and aberran e ratios such as those found in this study do o necessarily indicate that *varius* and *tricolo* r separate species, particularly in view of Go n and Strasburg's recent work (1956. *Cope* 9–18), on the even more markedly dimor Hawaiian moringuid eels.

The name to be applied to our *Gomp* cannot be verified at this time. *Gomphosus v* Lacepede (1802. *Hist. Nat. Poiss.* 3:100, 4 predates *G. tricolor* Quoy and Gaimard (1 Voyage *Uranie*, Zool.: 280), the type local e being Tahiti and the Hawaiian Islands spectively. We accordingly refer our materia *varius*, but with the following reservation. In h Indian Ocean the central Pacific forms of *G phosus* are replaced by two or three other spec one or two of which may be identical with h Pacific *varius*. Based on our experience it w l appear that sexual dimorphism is also pres in the Indian Ocean *Gomphosus*, and that m le may occur as either the blue-green *tricolor* f or as a violet-blue species called *coeruleus*. h precise relationship of the Indian Ocean to h Pacific *Gomphosus* remains to be demonstra When this is done it may be that what we call *varius* will be synonymized with *coeru*

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MARQUESAS AREA FISHERY AND ENVIRONMENTAL DATA, OCTOBER 1957 – JUNE 1958

SPECIAL SCIENTIFIC REPORT — FISHERIES No. 283

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Explanatory Note

The series embodies results of investigations, usually of restricted scope, intended to or direct management or utilization practices and as guides for administrative or legislative acti It is issued in limited quantities for the official use of Federal, State, or cooperating Agencies in processed form for economy and to avoid delay in publication.

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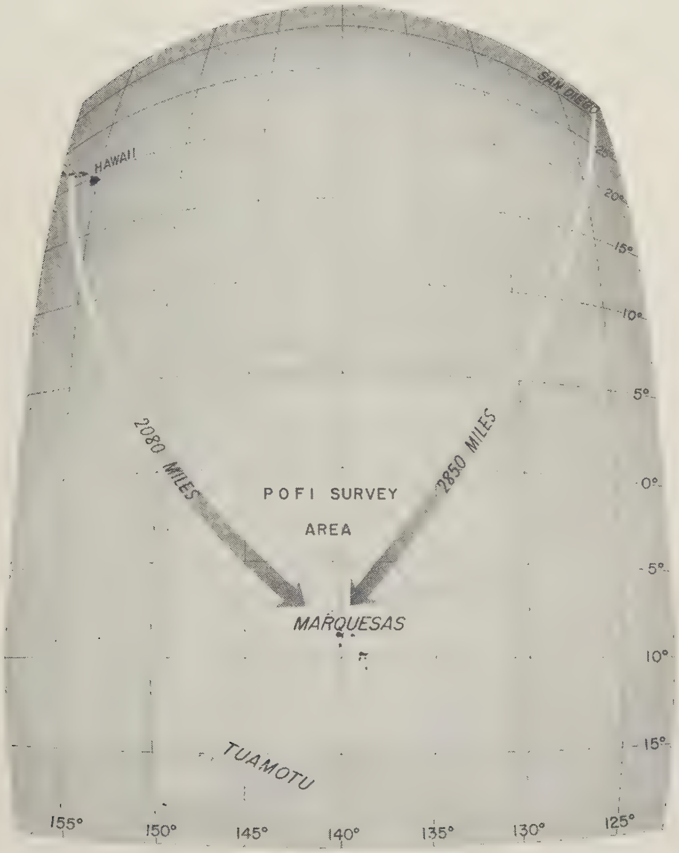
HAWAII
SAN DIEGO
20°
15°
10°
5°
0°
5°
10°
15°
2080 MILES
2850 MILES
POFI SURVEY
AREA
MARQUESAS
TUAMOTU
155°
150°
145°
140°
135°
130°
125°

MARQUESAS AREA FISHERY AND ENVIRONMENTAL DATA, OCTOBER 1957 - JUNE 1958

By
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Special Scientific Report--Fisheries No. 283

WASHINGTON: NOVEMBER 1958

ABSTRACT

This report presents the biological, environmental, and meteorological data from four consecutive cruises, October 1957 to June 1958, in the part of the southeastern Pacific Ocean that is centered in the Marquesas Islands. Primary mission of these cruises was to define the season of greatest availability of surface tuna schools in the Marquesas area.

Tabulated data include the following: observations of weather, water color, and water transparency; determinations of zooplankton volumes, surface salinities, and phosphates; observations at bathythermograph lowerings, tuna school sightings, surface fishing operations, and baitfish surveys.

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MARQUESAS AREA FISHERY AND ENVIRONMENTAL DATA, OCTOBER 1957 - JUNE 1958

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The purpose of this report is to present the record of observed data made during four consecutive cruises in the part of the southeastern Pacific Ocean that is centered in the Marquesas Islands. The cruises were part of a program undertaken by the Pacific Oceanic Fishery Investigations (POFI) to study the tuna resources of the southeastern Pacific. It is the third POFI report which presents observed data from this area. The first (Austin 1957) contains the record of observed data made during cruises in August and September 1956. The second (Wilson and Rinkel 1957) contains results from cruises made during January-March 1957.

In order to make these data rapidly available to other agencies studying the Pacific Ocean, they are presented here without analysis. Descriptive and analytical reports will follow.

The primary mission of the four expeditions was to continue the surface tuna school surveys in the Marquesas area, with the cruises scheduled so that the season of greatest availability of tuna schools might be revealed. Secondary missions were to continue the study of the biology of the tuna and of live-bait resources in the Marquesas area, to continue the marking of tunas with the D-2 dart tag (Yamashita and Waldron 1958) and to continue studies of the abundance and distribution of tuna larvae.

Two POFI research vessels, the Charles H. Gilbert and the Hugh M. Smith, were assigned (fig. 1). In order to accomplish the primary mission, two types of surface tuna school surveys were carried out, the inshore and the offshore (fig. 2). The cruise and survey dates are listed in table 1.

In addition, another important mission was included in cruise 45 of the Smith. In cooperation with the R/V Horizon of the Scripps Institution of Oceanography, a study of the Equatorial Undercurrent was carried out during the period April 4-29, 1958, as part of the International Geophysical Year program. Preliminary results of this survey have been reported by Knauss and King (1958).

Table 1.--Marquesas Islands cruises

Vessel and cruise No.	Cruise period	Survey dates	
		Inshore	Offshore
Charles H. Gilbert 35	Oct. 2-Dec. 14, 1957	Oct. 14-20 Nov. 24-30	Oct. 24-Nov. 6
Hugh M. Smith 43	Jan. 3-Feb. 25, 1958	Jan. 18-25	Jan. 27-Feb. 12
Charles H. Gilbert 38	Feb. 7-May 2, 1958	Feb. 27-Mar. 8 April 11-19	Mar. 26-Apr. 8
Hugh M. Smith 45	Mar. 28-June 23, 1958	June 1-10	May 14-29

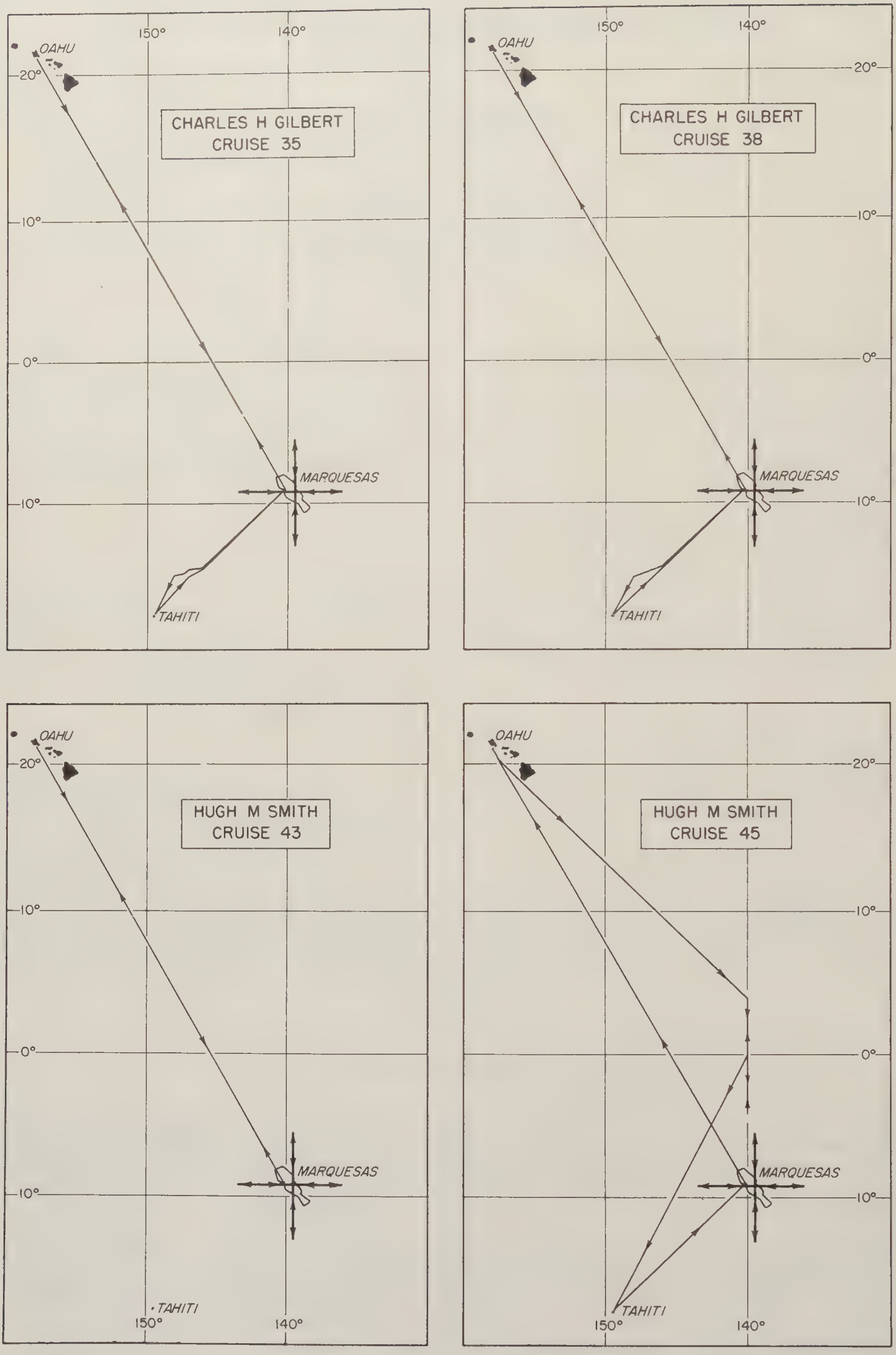
150°
140°
OAHU
20°
CHARLES H GILBERT
CRUISE 35
10°
0°
MARQUESAS
10°
TAHITI
150°
140°
OAHU
20°
CHARLES H GILBERT
CRUISE 38
10°
0°
MARQUESAS
10°
TAHITI
OAHU
20°
HUGH M SMITH
CRUISE 43
10°
0°
MARQUESAS
10°
TAHITI
150°
140°
OAHU
20°
HUGH M SMITH
CRUISE 45
10°
0°
MARQUESAS
10°
TAHITI
150°
140°

Figure 1.--Vessel tracks of four cruises.

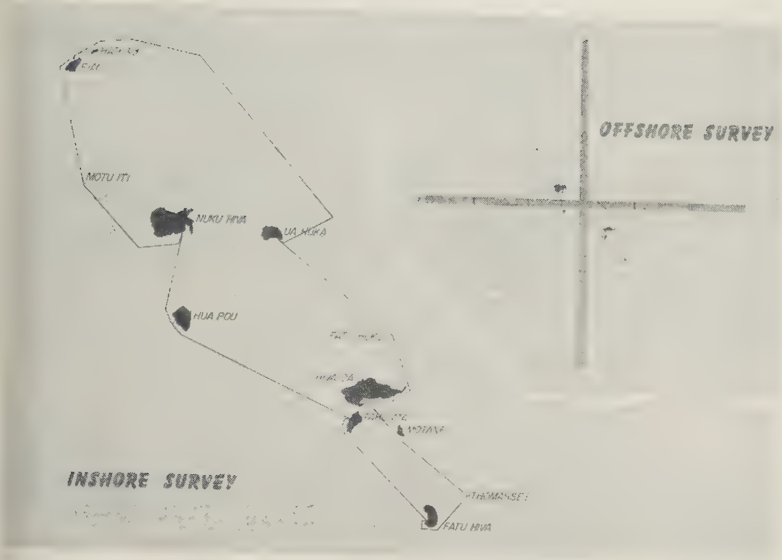

Figure 2.--Standardized inshore and offshore survey tracks, Marquesas area.

FIELD PROCEDURES

Bathythermograph and Meteorological observations

Except where noted below, bathythermograph (BT) lowerings on the four cruises were made according to the following schedule: every 6 hours between Honolulu and latitude 11°N., every 3 hours between latitude 11°N. and the Marquesas, local noon daily in the Marquesas area while on both inshore and offshore surveys, every 3 hours on the offshore survey, at each tuna fishing station, and every 6 hours on the run between Tahiti and the Marquesas.

BT lowerings during cruise 38 of the *ilbert* were made every 6 hours enroute rom Honolulu to the first longline fishing staion at latitude 5°N., longitude 150°W. Three owerings were made at each of the seven fishng stations; one immediately after setting, the econd just prior to retrieving, and the third mmediately after retrieving the longline gear. ne BT lowering was made mid-way between ishing stations along 150°W. longitude (fig. 1). side from the foregoing deviations, BT lowerngs were made following the schedule listed bove.

The BT schedule followed during cruise 5 of the *Smith* differed only in that lowerings ere made every 6 hours to latitude 4°N. on e run south from Honolulu.

Nine hundred-foot BT's were used on all the cruises. Observations made in conjunction with BT lowerings were coded according to H. O. Pub. 606-c, and recorded on Oceanographic Log Sheet B. These observations are presented in tables 2, 3, 4, and 5. The observations made during that portion of *Smith* cruise 45 concerned with the Undercurrent are not included here.

BT lowerings totalled 295 during *Gilbert* cruise 35, 263 during *Smith* cruise 43, 336 during *Gilbert* cruise 38, and 264 during *Smith* cruise 45.

Determinations from analyses of surface salinity and surface inorganic phosphate samples taken at BT lowerings are included in tables 2, 3, 4, and 5. Surface salinity values plus surface temperatures for locations other than BT lowerings are presented in table 10. Both the surface salinity and surface inorganic phosphate samples were returned ashore for analysis with the exception that some phosphate samples were analyzed aboard the vessel during *Smith* cruise 45. The phosphate samples were frozen as a means of preservation.

During the four cruises, standard weather observations were made up to 4 times daily. They were omitted when the vessels were in bays or harbors, and were made sporadically during fishing periods. The observations, as encoded according to U. S. Weather Bureau Form 1210-F, are presented in tables 6, 7, 8, and 9. Weather observations made during the Undercurrent survey portion of the *Smith* are not included in table 9, and will be presented elsewhere.

Productivity observations

Water color and transparency observations were made routinely at local noon daily, during survey periods in the Marquesas area. The transparency measurements were made by lowering a 30-cm. Secchi disc. The water color observations were made by comparison with the Forel standard. In addition, photometer readings were made during *Smith* cruise 45 at the diurnal variability station (9°34'S., 139°50'W) and between 5°S. and 10°N. on the run between the Marquesas and Honolulu. These and related data are presented in tables 11, 12, 13, and 14.

Three types of plankton hauls were made during the four cruises with a 1-meter net of 656 Nitex (aperture width 0.66 mm.), similar to that which has been described by King and Demond (1953). The purpose of these hauls was to obtain a measure of the standing crop of zooplankton, and to determine the distribution and abundance of tuna larvae. On all the four cruises, a 30-minute oblique tow to a depth of 140 meters was made each night during the runs to and from the Marquesas. During the offshore surveys in the Marquesas, two 0-140 meter tows were made nightly. During the offshore survey conducted during Gilbert cruise 35, these nightly tows were paired half-hour tows.

Upon completion of the inshore surveys conducted during all four cruises, a 24-hour plankton station was occupied at latitude 9°34'S., longitude 139°50'W. The purpose of this station was to obtain data on the diurnal variability of zooplankton and tuna larvae. Two of these stations were occupied during Gilbert cruise 35, and paired 0-140 meter half-hour tows were made every 3 hours. One station was occupied during Smith cruise 43, and a single 0-140 meter half-hour tow was made every 2 hours. Two stations were occupied during Gilbert cruise 38, and single 0-140 meter half-hour tows were made every 2 hours. At the one station occupied during Smith cruise 45, 2-net tows were made, a 1-meter open net towing in the depth range 0-140 meters and a 1-meter closing net in the depth range 140-280 meters. The latter type of net has been described by King et al. (1957). These half-hour 2-net tows were made every 2 hours.

Seven half-hour 0-140 meter hauls were made at night between the Marquesas and Tahiti, during Gilbert cruise 35. The station data and plankton volumes for hauls made during the four cruises are presented in tables 15, 16, 17, and 18.

Surface trolling

Except when otherwise engaged, the vessels did surface trolling during daylight hours with varying numbers of lines. The catches and related data for the four cruises are presented in tables 20, 21, 22, and 23. The common and scientific names of fish caught are listed in table 19.

Longline fishing

During Gilbert cruise 38 a series of seven longline fishing stations was occupied along longitude 150°W. between latitude 5°N. and 1°S. (fig. 1). At each station, 44 baskets of 11-hook longline gear were set. The gear used was of POFI design, as described by Mann (1955). Pacific herring (Clupea pallasii) was used as bait. The longline station data and catch per 100 hooks are presented in table 24; the catch record and sizes of fish in table 25.

Live-bait fishing

During the course of the inshore and offshore surveys in the Marquesas and in the Tuamotus, fishing trials with live-bait were made on tuna schools encountered. The purpose of these fishing trials was to determine the species and size of tuna in the school, to obtain material for biological studies, to continue the tagging of tunas, and to make observations of biting behavior. The live-bait fishing techniques used were similar to those of the Hawaiian skipjack fishery, as described by June (1951). The Marquesan sardine was used as bait. The station data, catches, and amount of bait used in tuna school fishing trials during the four cruises are presented in tables 26, 27, 28, and 29. The length frequency by sex of samples of yellowfin and skipjack caught during these fishing trials are given in tables 30 through 34, inclusive.

Baitfish surveys

Two procedures were used for conducting baitfish surveys in the Marquesas; daylight visual scouting and night-light fishing. Scouting during the day was done by three or four swimmers, equipped with faceplates, making a visual sweep of the shallow water in the bays, and noting the schools of bait-sized fish. The procedure and equipment used for capturing bait during the day has been described by June (1951). Night-light fishing was done with the vessels anchored in about 40-foot depth of water. Marquesan sardines of all sizes were found to be attracted to the diffused light from a floodlight, and the fish were caught alongside the vessel by using a night net of specialized design. The results of visual scouting, day and night-light fishing for the four cruises are given in tables 35 through 38, inclusive. The length frequency by sex of Marquesan sardine samples is presented in tables 39 through 42, inclusive.

Birds, tuna schools, and aquatic mammals

During daylight hours on all four cruises, a watch was maintained for birds, tuna schools, and aquatic mammals. Summaries of these observations are presented in tables 43 through 47 inclusive.

Field party personnel

Charles H. Gilbert - William T. Tanaka, Master

Cruise 35
Robert C. Wilson, Field Party Chief
Eugene L. Nakamura, Fishery Research Biologist

Cruise 38
Tamio Otsu, Field Party Chief
Howard O. Yoshida, Fishery Research Biologist

Hugh M. Smith - Barnes Collinson, Master

Cruise 43
Donald W. Strasburg, Field Party Chief
Richard N. Uchida, Fishery Research Biologist

Cruise 45
Joseph E. King, Field Party Chief
Murice O. Rinkel, Oceanographer
Richard J. Hansen, Fishery Aid
John W. Van Landingham, Physical Science Aid
Takuji Fujimura, Collaborator, Hawaii Division of Fish and Game
Stanley I. Shima, Collaborator, Hawaii Division of Fish and Game

LABORATORY PROCEDURES

alinity and Phosphate determinations

The salinity samples were analyzed by a odification of the method of Knudsen (Van andingham 1957). The inorganic phosphate mples were analyzed by the hydrazine sul- ate modification of Denige's method (King al. 1957).

oplankton

Details of the method for determining splacement volumes of zooplankton are des- ibed by King and Hida (1957).

Personnel processing samples and data
(In addition to the authors)

John W. Van Landingham, Physical Science Aid
Thomas M. Okano, Physical Science Aid
Mary Lynne M. Godfrey, Physical Science Aid
Betty Ann L. Keala, Statistical Clerk

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Table 2. --Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
1	0000	10/4	18°55'N	155°52'W	80.2	110	10	80.0	74.5	1012	03	6	4	9	3	100	1	-	-
2	0600	10/4	18°10'N	155°28'W	79.2	080	13	79.9	75.0	1015	00	8	3	6	3	100	1	-	-
3	1200	10/4	17°26'N	155°04'W	78.0	080	14	78.0	73.8	1012	00	X	X	8	3	090	1	-	-
4	1800	10/4	16°41'N	154°37'W	79.4	080	15	80.0	73.8	1013	00	8	3	9	3	090	1	-	-
5	0000	10/5	15°57'N	154°03'W	80.0	070	10	80.5	75.0	1011	02	6	4	9	3	090	1	-	-
6	0600	10/5	15°10'N	153°27'W	79.7	060	13	80.0	75.0	1012	02	8,6	3	6	3	090	1	-	-
7	1200	10/5	14°26'N	153°03'W	XXX	080	15	81.0	75.0	1010	02	8,6	3	9	3	090	1	-	-
8	1800	10/5	13°41'N	152°40'W	81.1	080	14	81.3	76.0	1012	03	8,6	8	8	3	100	1	-	-
9	0000	10/6	12°57'N	152°15'W	82.1	050	04	81.6	77.0	1010	03	8,6	8	8	3	100	1	-	-
10	0600	10/6	12°12'N	151°48'W	82.2	080	06	81.0	76.0	1012	16	8,6	8	6	2	100	1	-	-
11	1200	10/6	11°26'N	151°21'W	81.5	100	10	81.0	76.0	1011	16	8,6	8	6	2	100	1	-	-
12	1500	10/6	11°03'N	151°06'W	81.0	040	09	81.5	74.5	1011	16	8,6	8	6	2	100	1	-	-
13	1800	10/6	10°39'N	150°52'W	82.1	090	09	83.0	77.0	1012	14	8,6	8	6	2	090	1	-	-
14	2100	10/6	10°16'N	150°38'W	82.4	100	04	83.2	77.0	1013	02	8,6	8	7	2	090	1	-	-
15	0000	10/7	09°53'N	150°25'W	82.1	090	07	81.6	76.1	1010	02	8,6	8	7	2	100	1	-	-
16	0300	10/7	09°31'N	150°11'W	81.9	120	12	80.0	77.0	1010	21	8,6	8	6	2	120	1	-	-
17	0600	10/7	09°08'N	149°57'W	82.2	090	14	80.3	76.0	1012	02	6,8	8	7	2	090	1	-	-
18	0900	10/7	08°47'N	149°44'W	82.7	000	00	80.3	75.3	1012	02	6,8	8	8	2	090	1	-	-
19	1200	10/7	08°25'N	149°30'W	81.6	140	01	80.1	75.5	1010	02	8,6	8	7	2	090	1	-	-
20	1500	10/7	08°03'N	149°16'W	82.6	150	09	82.6	77.1	1010	01	8,6	6	7	2	100	1	-	-
21	1800	10/7	07°41'N	149°02'W	83.0	150	13	84.0	77.2	1010	02	8,6	5	8	2	120	1	-	-
22	2100	10/7	07°19'N	148°48'W	83.9	150	13	84.0	77.0	1012	01	6	3	9	3	150	1	-	-
23	0000	10/8	06°58'N	148°35'W	83.8	120	12	83.8	77.3	1009	02	8	5	9	3	150	1	-	-
24	0300	10/8	06°39'N	148°22'W	84.0	100	11	83.0	78.0	1010	02	8	6	9	3	140	1	-	-
25	No slide - BT damaged.																		
26	0900	10/8	06°00'N	147°57'W	82.0	120	14	81.8	76.0	1012	02	8	5	9	3	120	1	-	-
27	1200	10/8	05°40'N	147°44'W	81.8	110	10	81.8	75.3	1010	01	8	2	7	3	130	1	-	-
28	1500	10/8	05°21'N	147°31'W	81.0	120	09	81.1	75.4	1010	02	8,6	2	7	3	140	1	-	-
29	1800	10/8	05°01'N	147°18'W	81.0	130	14	82.0	76.0	1013	02	8,4	3	9	3	130	1	35.07	0.28
30	2100	10/8	04°41'N	147°06'W	81.9	140	13	83.0	76.5	1012	03	8,4	5	9	3	130	1	-	-
31	0000	10/9	04°20'N	146°54'W	81.8	150	11	82.0	74.8	1009	02	8,4	4	9	3	130	1	35.07	0.36
32	0300	10/9	03°59'N	146°45'W	81.3	140	11	81.8	74.5	1010	01	8	2	9	3	130	1	-	-
33	0600	10/9	03°38'N	146°34'W	81.2	130	10	81.3	74.0	1012	02	8	1	9	2	120	1	35.06	0.24
34	0900	10/9	03°17'N	146°22'W	80.8	140	14	81.0	75.0	1012	02	8	3	9	2	130	1	-	-
35	1200	10/9	02°55'N	146°12'W	80.4	150	11	80.0	74.0	1010	02	8,4	3	7	2	150	1	34.98	0.37

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
36	1500	10/9	02°34'N	146°00'W	79.4	150	15	78.8	74.8	1011	02	8	2	7	2	150	1	-	-
37	1800	10/9	02°12'N	145°49'W	80.6	150	09	81.0	76.0	1012	02	8	1	9	2	150	1	35.04	0.31
38	2100	10/9	01°51'N	145°38'W	80.1	150	09	81.2	75.5	1012	02	8	2	9	2	150	1	-	-
39	0000	10/10	01°29'N	145°24'W	80.1	150	09	80.8	75.1	1010	03	4,8	8	9	2	140	1	35.20	0.34
40	0300	10/10	01°07'N	145°08'W	80.1	120	11	80.8	75.1	1010	01	4,8	3	9	2	140	1	-	-
41	0600	10/10	00°46'N	144°52'W	79.7	120	10	81.0	75.0	1012	02	8	1	9	2	140	1	35.30	0.41
42	0900	10/10	00°24'N	144°37'W	79.7	120	10	80.3	75.5	1012	02	8,6	2	9	2	130	1	-	-
43	1200	10/10	00°02'N	144°23'W	79.1	110	10	79.3	75.8	1010	02	8	3	7	2	140	1	35.34	0.34
44	1500	10/10	00°21'S	144°11'W	78.8	140	08	79.2	75.0	XXXX	03	4,8	6	8	2	140	1	-	-
45	1800	10/10	00°44'S	143°58'W	79.7	130	11	81.0	76.3	1012	02	8	4	9	2	140	1	35.30	0.52
46	2100	10/10	01°06'S	143°46'W	80.0	100	13	81.0	76.2	1011	02	8,6	5	9	2	130	1	-	-
47	0000	10/11	01°31'S	143°36'W	80.0	120	09	80.0	75.0	1009	02	8	3	9	2	130	1	35.35	0.36
48	0300	10/11	01°57'S	143°28'W	80.1	100	10	80.3	75.5	1010	16	8	7	9	2	130	1	-	-
49	0600	10/11	02°21'S	143°20'W	79.9	110	13	81.2	75.3	1012	03	6	8	8	2	120	1	35.40	0.38
50	0900	10/11	02°45'S	143°13'W	80.1	130	11	80.2	75.1	1012	02	8,4	8	8	2	130	1	-	-
51	1200	10/11	03°10'S	143°05'W	79.3	110	13	79.7	75.1	1012	02	8	7	7	2	130	1	35.43	0.36
52	1500	10/11	03°33'S	142°57'W	79.4	120	12	79.6	75.0	1012	01	8	3	8	2	130	1	-	-
53	1800	10/11	03°59'S	142°48'W	79.9	110	15	81.2	75.3	1014	01	X	0	9	3	120	1	35.46	0.45
54	2100	10/11	04°24'S	142°38'W	80.3	130	12	81.6	74.8	1012	01	X	0	9	3	120	1	-	-
55	0000	10/12	04°48'S	142°30'W	80.4	120	12	80.6	75.3	1009	02	X	0	9	2	120	1	35.51	0.38
56	0300	10/12	05°13'S	142°20'W	80.8	120	09	80.9	74.8	1010	02	X	0	9	2	120	1	-	-
57	0600	10/12	05°34'S	142°10'W	80.3	100	11	81.0	75.3	1012	02	X	0	9	2	120	1	35.52	0.36
58	0900	10/12	05°54'S	141°58'W	80.8	110	10	81.0	74.4	1012	03	8	3	9	2	120	1	-	-
59	1200	10/12	06°14'S	141°45'W	80.5	110	07	80.0	73.0	1011	01	8	1	7	2	120	1	35.52	0.27
60	1500	10/12	06°33'S	141°32'W	80.9	080	09	79.9	72.9	XXXX	03	8	2	9	2	120	1	-	-
61	1800	10/12	06°55'S	141°21'W	81.0	110	09	81.2	74.3	1014	01	8	1	9	2	110	1	35.58	0.38
62	2100	10/12	07°16'S	141°09'W	82.3	110	08	81.8	74.5	1013	02	8	1	9	2	110	1	-	-
63	0000	10/13	07°37'S	140°58'W	82.0	100	09	81.2	74.7	1012	02	8	1	9	2	110	1	-	0.36
64	0300	10/13	07°59'S	140°46'W	81.4	080	11	81.1	75.0	1012	02	8	2	9	2	110	1	-	-
65	0600	10/13	08°18'S	140°35'W	81.7	090	14	82.5	75.5	1013	02	8	2	9	2	110	1	35.67	0.32
66	0900	10/13	08°38'S	140°24'W	80.9	080	12	81.2	75.3	1014	02	8	1	9	2	090	1	-	-
67	2145	10/14	08°23'S	140°32'W	82.2	070	15	82.2	75.3	1013	01	8	6	8	2	070	1	35.64	0.78
68	2100	10/15	07°47'S	140°02'W	81.7	080	10	81.7	75.0	1012	15	8	5	9	2	080	1	35.51	0.30
69	2100	10/16	08°40'S	139°20'W	81.8	090	12	82.0	77.0	1011	14	8	6	9	2	090	1	35.58	0.45
70	2100	10/17	09°32'S	138°52'W	81.9	080	09	82.5	77.2	1012	15	8	6	8	2	090	1	35.71	0.28

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
71	1725	10/18	10°02'S	138°50'W	81.6	120	20	81.5	76.5	1015	14	8	8	9	3	120	1	-	-
72	2110	10/18	10°15'S	138°34'W	81.8	100	18	82.1	74.8	1010	02	8	7	7	3	120	3	35.60	0.36
73	1745	10/19	10°16'S	139°06'W	82.0	110	16	81.8	74.4	1014	02	8,5	8	9	4	120	3	-	-
74	2110	10/19	09°59'S	139°11'W	82.1	110	17	82.0	74.4	1012	02	8,5	8	9	4	120	3	35.73	0.33
75	2115	10/20	09°30'S	139°56'W	82.7	120	14	83.0	75.0	1013	01	8	2	8	2	120	1	35.68	0.31
76	1630	10/21	09°33'S	139°52'W	81.8	100	15	82.0	75.0	1014	03	8	6	8	3	100	1	-	-
77	1930	10/21	09°35'S	139°52'W	82.0	090	11	82.8	73.5	1014	02	8	6	9	3	100	1	-	-
78	2230	10/21	09°34'S	139°51'W	82.1	070	11	79.0	74.9	1012	03	8	8	9	3	090	1	-	-
79	0130	10/22	09°32'S	139°48'W	81.5	210	10	81.7	74.9	1012	15	8	6	9	3	090	1	-	-
80	0430	10/22	09°34'S	139°50'W	80.4	130	12	80.9	73.6	1014	01	8	2	9	2	100	1	-	-
81	0730	10/22	09°34'S	139°51'W	81.6	060	08	81.3	74.0	1015	00	X	X	9	2	100	1	-	-
82	1030	10/22	09°32'S	139°51'W	81.5	110	08	80.8	73.3	1014	00	X	X	9	2	100	1	-	-
83	1330	10/22	09°33'S	139°50'W	80.9	100	07	80.8	74.0	1014	00	X	X	9	2	100	1	-	-
84	1800	10/24	09°06'S	139°32'W	80.7	090	16	82.2	76.0	1014	02	8	5	9	3	090	1	35.72	0.37
85	2100	10/24	09°06'S	139°11'W	81.8	090	15	83.5	76.2	1012	02	8	4	9	3	090	1	35.71	0.35
86	0000	10/25	09°08'S	138°50'W	81.7	090	13	82.2	76.3	1012	02	8	5	9	3	090	1	35.66	0.44
87	0300	10/25	09°09'S	138°28'W	80.8	090	12	82.0	76.5	1012	01	8	5	9	3	090	1	35.59	0.31
88	0600	10/25	09°13'S	138°06'W	80.3	070	09	81.2	75.7	1015	02	8	3	5	2	090	1	35.73	0.45
89	0900	10/25	09°18'S	137°48'W	81.4	060	09	80.5	75.3	1014	02	8	4	5	2	090	1	35.72	0.35
90	1315	10/25	09°23'S	137°24'W	80.1	090	10	80.4	75.4	1007	01	8	2	5	2	090	1	35.61	0.38
91	1500	10/25	09°27'S	137°08'W	80.1	090	08	80.3	75.0	1014	02	8	3	7	2	090	1	35.58	0.42
92	1800	10/25	09°22'S	136°44'W	80.3	090	12	81.3	74.3	1016	02	8	5	9	2	090	1	35.52	0.41
93	2100	10/25	09°18'S	136°22'W	81.3	090	10	81.3	74.5	1014	01	8	2	9	2	090	1	35.59	0.43
94	0000	10/26	09°16'S	136°02'W	81.0	090	09	82.2	74.5	1012	01	8,4	2	9	2	090	1	35.54	0.42
95	0300	10/26	09°16'S	135°40'W	81.0	090	12	81.2	74.0	1012	03	8	4	9	2	090	1	-	0.36
96	0600	10/26	09°15'S	136°05'W	80.6	090	12	81.7	74.7	1015	02	8	2	5	2	090	1	35.58	0.44
97	0900	10/26	09°15'S	136°17'W	80.7	090	10	80.5	73.0	1014	02	8	2	5	2	090	1	35.57	0.44
98	1315	10/26	09°14'S	136°30'W	80.4	060	12	80.4	73.9	1012	03	8	5	5	2	090	1	35.56	0.37
99	1500	10/26	09°14'S	136°48'W	80.6	090	12	81.0	73.9	1014	16	8	7	7	2	090	1	35.52	0.36
100	1820	10/26	09°14'S	137°16'W	81.3	090	09	83.0	75.0	1015	02	8	7	9	1	090	1	35.54	0.45
101	2100	10/26	09°13'S	137°37'W	82.2	090	12	82.3	76.0	1015	03	8	8	9	1	090	1	35.63	0.42
102	0000	10/27	09°16'S	138°02'W	82.0	080	10	83.0	76.0	1012	02	8	8	9	1	090	1	35.69	0.36
103	0300	10/27	09°19'S	138°28'W	81.5	080	12	81.5	75.5	1012	01	8	4	9	2	090	1	35.65	0.51
104	0600	10/27	09°18'S	138°50'W	81.1	100	12	81.1	74.1	1014	02	8	3	7	2	090	1	35.66	0.36
105	0900	10/27	09°17'S	138°58'W	81.2	080	10	79.8	75.5	1014	25	8	5	6	2	090	1	35.62	0.36

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
106	1300	10/27	09°20'S	139°12'W	81.4	090	10	81.1	75.9	1012	00	X	X	6	2	090	1	35.66	0.39
107	1500	10/27	09°18'S	139°37'W	81.5	070	13	80.0	74.9	1014	15	8	6	9	2	090	1	35.62	0.30
108	1800	10/27	09°38'S	139°37'W	81.8	070	15	81.8	75.2	1015	03	8,6	7	9	3	080	1	35.73	0.37
109	2100	10/27	09°50'S	139°34'W	82.0	080	15	82.5	75.0	1013	02	8,6	8	9	3	080	1	36.46	0.38
110	0000	10/28	10°10'S	139°34'W	82.0	090	16	82.0	76.3	1012	02	8,6	5	9	3	090	1	35.78	0.31
111	0300	10/28	10°34'S	139°34'W	81.7	090	13	82.3	75.7	1013	03	4,8	5	9	3	090	1	35.78	0.29
112	0600	10/28	10°49'S	139°34'W	81.7	090	15	81.3	76.0	1015	02	8	4	7	3	090	1	35.78	0.38
113	0900	10/28	11°05'S	139°30'W	81.8	100	15	81.2	76.0	1014	25	8	4	6	3	090	1	35.76	0.32
114	1300	10/28	11°23'S	139°23'W	82.0	090	05	78.2	74.9	1014	25	8	6	5	3	090	1	35.83	0.29
115	1500	10/28	11°39'S	139°25'W	81.4	090	19	81.4	75.0	1014	15	8	6	8	3	090	1	35.87	0.48
116	1800	10/28	12°00'S	139°28'W	81.8	070	16	82.2	76.0	1016	01	8	5	9	4	090	1	35.87	0.30
117	2100	10/28	12°20'S	139°32'W	82.0	090	17	81.8	75.2	1014	02	8	5	9	4	090	1	35.89	0.31
118	0000	10/29	12°39'S	139°34'W	81.5	090	15	82.5	75.5	1013	02	8	5	9	4	090	1	36.04	0.25
119	0300	10/29	12°56'S	139°36'W	80.2	080	19	81.0	74.8	1016	02	8	4	9	4	090	1	36.14	0.23
120	0600	10/29	12°36'S	139°36'W	81.1	080	14	81.8	75.8	1015	02	8	4	6	3	090	1	36.14	0.28
121	0900	10/29	12°24'S	139°32'W	81.7	080	18	81.8	74.9	1014	02	8	4	6	3	090	1	36.08	0.38
122	1300	10/29	12°10'S	139°26'W	81.5	080	18	80.2	75.5	1014	02	8	5	6	3	090	1	36.00	0.25
123	1500	10/29	11°58'S	139°26'W	81.7	080	14	80.9	74.8	1014	15	8	7	9	3	090	1	35.98	0.26
124	1800	10/29	11°38'S	139°26'W	82.1	120	14	80.0	76.5	1015	15	8	7	7	3	100	1	35.88	0.32
125	2100	10/29	11°20'S	139°25'W	82.2	070	17	80.5	76.0	1014	02	8,6	8	8	3	090	1	35.81	0.29
126	0000	10/30	11°00'S	139°29'W	81.8	070	18	81.0	74.5	1012	02	8,6	9	7	3	090	1	35.78	0.37
127	0300	10/30	10°38'S	139°35'W	81.3	080	15	81.5	76.2	1012	02	8,6	7	8	3	090	1	35.78	0.37
128	0600	10/30	10°14'S	139°40'W	81.5	080	17	81.5	75.2	1013	02	8	5	7	2	090	1	35.77	0.27
129	1300	10/30	09°36'S	139°40'W	81.3	080	17	81.1	74.0	1011	01	8	2	7	2	090	1	35.76	0.32
130	1500	10/30	09°12'S	139°40'W	81.4	080	17	80.8	75.0	1011	02	8	2	8	2	090	1	35.73	0.40
131	1815	11/1	08°56'S	139°37'W	81.0	080	20	83.5	76.0	1014	02	8	3	8	3	080	1	35.61	0.48
132	2100	11/1	08°28'S	139°36'W	81.8	080	16	82.3	76.0	1012	03	8,6	5	8	4	080	1	35.59	0.50
133	0000	11/2	08°06'S	139°35'W	81.3	080	16	82.0	76.2	1010	03	6	7	8	4	080	1	35.59	0.59
134	0300	11/2	07°47'S	139°35'W	80.8	090	15	80.6	75.0	1010	01	8	5	8	4	080	1	35.59	0.48
135	0600	11/2	07°28'S	139°35'W	80.5	080	16	80.7	75.9	1012	02	8	4	6	4	080	1	35.55	0.55
136	0900	11/2	07°20'S	139°32'W	80.2	100	15	80.2	75.8	1011	03	8	6	6	3	080	1	35.55	0.54
137	1300	11/2	07°08'S	139°28'W	79.7	100	16	80.0	74.5	1010	02	8	4	6	3	080	1	35.57	0.44
138	1500	11/2	06°54'S	139°28'W	80.1	100	16	80.0	74.5	1011	02	8,1	3	8	3	080	1	35.57	0.49
139	1800	11/2	06°33'S	139°32'W	80.0	080	18	80.8	75.5	1012	02	8	5	8	3	080	1	35.52	0.54
140	2100	11/2	06°12'S	139°39'W	80.8	100	18	81.2	75.1	1014	02	8	5	8	3	080	1	35.53	0.60

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
141	0000	11/3	05°52'S	139°40'W	80.9	080	12	80.8	75.0	1008	02	8,4	3	9	3	080	1	35.57	0.49
142	0300	11/3	05°31'S	139°40'W	80.2	090	15	80.0	75.0	1008	02	8	5	9	3	080	1	35.55	0.46
143	0600	11/3	05°48'S	139°46'W	79.7	100	15	80.3	74.8	1010	02	8	4	6	3	080	1	35.55	0.51
144	0900	11/3	06°04'S	139°49'W	79.9	100	15	80.1	75.0	1010	01	5,8	3	6	3	080	1	35.57	0.49
145	1300	11/3	06°27'S	139°50'W	79.9	110	10	79.9	74.7	1009	01	8	2	6	3	080	1	35.57	0.62
146	1500	11/3	06°41'S	139°51'W	80.0	110	10	79.9	74.9	1010	02	8	2	8	3	080	1	35.57	0.43
147	1850	11/3	07°01'S	139°56'W	80.8	080	14	82.0	76.2	1012	01	6	3	9	2	080	1	35.57	0.44
148	2100	11/3	07°17'S	139°51'W	80.8	110	12	80.0	76.5	1011	03	8,6	8	8	3	090	1	35.57	0.45
149	2330	11/3	07°32'S	139°52'W	81.0	070	12	81.2	76.2	1010	02	8	2	8	2	090	1	-	-
150	0300	11/4	08°00'S	139°36'W	80.5	090	06	82.0	76.5	1010	14	8,6	8	8	3	090	1	35.55	0.45
151	0600	11/4	08°22'S	139°31'W	80.9	100	17	81.5	75.1	1012	01	8	2	7	3	100	1	35.59	0.52
152	0900	11/4	08°38'S	139°28'W	81.0	110	13	81.0	75.7	1011	02	8	2	7	3	100	1	35.59	0.41
153	1300	11/4	08°56'S	139°41'W	81.3	090	09	80.5	74.0	1011	02	8	2	6	2	100	1	35.64	0.41
154	1500	11/4	09°10'S	139°39'W	81.0	110	12	81.0	74.9	1012	02	8	3	8	2	100	1	35.66	0.36
155	1800	11/4	09°12'S	140°00'W	81.8	090	14	84.0	75.0	1014	02	8	3	9	2	090	1	35.70	0.42
156	2100	11/4	09°13'S	140°19'W	82.2	090	12	84.0	75.0	1012	02	8	3	9	2	090	1	35.66	0.34
157	0000	11/5	09°13'S	140°36'W	82.0	090	10	84.0	75.0	1008	01	8	1	9	2	090	1	35.64	0.42
158	0215	11/5	09°13'S	140°43'W	82.0	090	12	82.0	76.0	1009	01	8	1	9	2	090	1	-	-
159	0300	11/5	09°14'S	141°00'W	81.7	100	13	81.6	75.0	1010	02	8	1	9	2	090	1	35.61	0.36
160	0600	11/5	09°14'S	141°20'W	82.0	110	15	81.3	76.0	1011	02	8	2	7	2	090	1	35.61	0.36
161	0900	11/5	09°13'S	141°40'W	81.4	090	13	80.1	74.8	1011	02	8	2	7	2	090	1	35.66	0.34
162	1300	11/5	09°15'S	142°02'W	80.3	090	15	81.3	75.0	1010	03	8	4	7	2	090	1	35.73	0.31
163	1500	11/5	09°14'S	142°19'W	82.1	090	15	81.8	74.8	1011	02	8	3	9	2	090	1	35.73	0.34
164	1800	11/5	09°13'S	142°42'W	82.5	090	15	85.0	76.2	1012	01	8	1	9	2	090	1	35.70	0.30
165	2100	11/5	09°12'S	143°06'W	83.2	090	14	85.0	75.5	1011	02	8	2	9	2	090	1	35.68	0.36
166	0000	11/6	09°11'S	143°23'W	83.1	090	09	85.0	76.0	1009	02	6	4	9	2	090	1	35.73	0.39
167	0300	11/6	09°12'S	143°18'W	82.5	090	12	83.5	76.5	1009	02	8	4	9	2	120	3	35.71	0.29
168	0600	11/6	09°14'S	143°00'W	82.0	110	14	82.5	76.0	1011	02	8	3	8	2	090	1	35.70	0.39
169	0900	11/6	09°18'S	142°42'W	82.0	100	12	82.0	75.1	1010	02	8	3	8	2	090	1	35.73	0.38
170	1300	11/6	09°18'S	142°19'W	82.0	090	12	81.8	75.0	1010	02	8	3	8	2	090	1	35.75	0.38
171	1500	11/6	09°18'S	142°06'W	82.0	090	14	81.7	75.3	1010	03	8,4	4	8	3	090	1	35.75	0.34
172	1800	11/6	09°16'S	141°47'W	81.6	080	18	82.5	75.0	1014	01	8	1	8	3	090	1	35.73	0.38
173	2100	11/6	09°16'S	141°29'W	81.2	080	13	82.7	74.8	1012	01	8	1	8	3	090	2	35.71	0.39
174	2245	11/6	09°16'S	141°22'W	82.2	080	16	82.5	74.0	1010	02	8	1	8	3	090	2	-	-
175	0000	11/7	09°16'S	141°16'W	81.4	080	09	83.8	74.2	1009	02	8	1	8	3	090	2	35.62	0.44

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
176	0300	11/7	09°18'S	141°00'W	80.8	090	11	82.0	74.8	1009	02	8	1	8	3	090	2	35.61	0.45
177	0600	11/7	09°18'S	140°44'W	81.5	090	12	81.4	74.1	1011	02	8, 5	2	7	3	090	2	35.62	0.46
178	0900	11/7	09°17'S	140°29'W	80.9	090	12	81.2	72.0	1010	02	8, 5	2	7	3	090	2	35.62	0.35
179	1300	11/7	09°15'S	140°08'W	80.8	110	14	80.8	74.0	1009	03	8	5	7	3	090	2	35.68	0.46
180	1500	11/8	09°10'S	140°22'W	81.5	120	16	81.2	75.2	1010	02	8	2	8	2	090	2	-	-
181	1800	11/8	09°26'S	140°41'W	81.7	110	16	83.0	76.0	1012	02	8	5	9	3	110	2	35.70	0.49
182	0000	11/9	10°02'S	141°20'W	82.4	110	16	82.8	75.5	1008	01	8	2	9	2	150	2	35.75	0.31
183	0600	11/9	10°46'S	141°55'W	81.4	110	16	83.0	76.5	1010	02	8	2	9	2	130	2	35.79	0.26
184	1200	11/9	11°28'S	142°23'W	82.0	110	18	81.5	75.5	1009	02	8	2	7	2	140	2	35.77	0.30
185	1800	11/9	12°08'S	143°01'W	82.6	080	11	83.0	77.2	1012	02	8	5	9	2	130	2	35.81	0.30
186	0000	11/10	12°44'S	143°47'W	83.7	070	11	84.8	77.0	1009	01	8, 1	2	9	2	130	2	35.79	0.26
187	0600	11/10	13°20'S	144°28'W	82.7	070	09	84.8	76.0	1010	00	X	X	9	1	100	1	35.79	0.48
188	1200	11/10	13°51'S	145°00'W	82.3	080	07	81.9	75.8	1010	02	8	2	7	1	100	1	35.85	0.26
189	1800	11/10	14°18'S	145°52'W	82.8	000	00	82.2	76.0	1012	15	8	7	7	1	090	1	36.01	0.20
190	2215	11/10	14°29'S	146°05'W	83.5	040	04	84.1	76.1	1010	01	8	2	9	1	090	1	-	-
191	1800	11/11	14°39'S	146°19'W	83.4	140	07	83.4	77.0	1012	02	8, 4	2	9	1	000	0	35.88	0.25
192	0000	11/12	14°52'S	147°02'W	84.0	130	13	83.5	75.0	1010	03	8	5	9	1	130	1	35.93	0.22
193	1800	11/12	14°55'S	148°02'W	83.7	080	14	83.8	77.0	1013	02	8, 6	3	9	1	100	1	36.27	0.21
194	0000	11/13	15°01'S	147°57'W	83.0	150	16	82.5	76.2	1011	02	8	3	9	1	150	1	36.24	0.19
195	0320	11/13	14°56'S	147°38'W	82.3	140	11	82.5	75.4	1011	02	8, 6	2	9	2	100	1	-	-
196	1800	11/13	15°13'S	148°00'W	82.5	140	15	81.9	75.3	1012	25	8	5	9	1	150	1	36.25	0.25
197	0000	11/14	15°52'S	148°16'W	82.0	120	12	82.0	74.0	1010	15	8, 5	6	9	1	150	1	36.33	0.23
198	0600	11/14	16°28'S	148°48'W	80.5	110	14	80.0	72.5	1012	00	X	X	9	1	110	1	36.36	0.23
199	1200	11/14	17°02'S	149°08'W	79.3	130	15	79.5	72.8	1010	01	8	3	9	1	120	1	36.32	0.17
200	0000	11/19	17°22'S	149°22'W	81.1	040	08	81.4	77.0	1010	15	8	6	8	1	070	1	36.27	0.22
201	0600	11/19	16°50'S	148°47'W	81.2	020	08	83.0	78.0	1012	00	X	9	2	2	070	1	36.36	0.18
202	1200	11/19	16°20'S	148°14'W	81.3	040	08	81.1	76.5	1010	00	X	5	5	2	070	1	36.42	0.22
203	1800	11/19	15°47'S	147°38'W	82.0	050	08	83.0	74.0	1012	01	8	3	9	2	080	1	36.32	0.22
204	2150	11/19	15°37'S	147°25'W	82.4	050	10	83.5	76.6	1011	02	8	3	9	2	080	1	-	-
205	0000	11/20	15°21'S	147°04'W	83.1	050	10	83.2	76.9	1009	02	8, 1	5	9	1	050	1	36.13	0.23
206	0600	11/20	14°58'S	146°21'W	82.5	050	08	80.0	76.2	1010	16	X	5	7	1	070	1	35.95	0.29
207	1200	11/20	14°36'S	145°40'W	82.9	040	04	81.1	75.1	1009	00	X	6	5	1	070	1	36.04	0.27
208	1800	11/20	14°03'S	145°04'W	82.3	060	13	79.0	75.0	1012	16	8, 6	7	6	1	070	1	-	0.29
209	0000	11/21	13°29'S	144°30'W	84.0	350	06	82.2	76.8	1009	02	8, 5	6	8	1	000	1	35.95	0.31
210	0600	11/21	12°54'S	143°56'W	82.6	040	09	83.0	76.0	1012	01	X	X	8	1	000	1	35.77	0.23

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind Dir., °T.	Wind Force, kt.	Air temp. Dry bulb, °F.	Air temp. Wet bulb, °F.	Barometer, mb.	Weather	Clouds Type	Clouds Cover	Visibility	Sea	Swell Dir. °T.	Swell Amt.	Surf. sal., ‰	Surf. PO4-P, µg at./L.
211	1200	11/21	12°22'S	143°22'W	82.9	040	12	82.3	75.1	1010	01	8	2	5	2	000	1	35.72	0.31
212	1800	11/21	11°46'S	142°48'W	82.0	030	13	83.2	76.5	1012	02	8	2	9	2	040	1	35.85	0.27
213	0000	11/22	11°12'S	142°13'W	83.1	030	09	83.5	75.6	1010	02	8,5	3	9	2	040	1	35.95	0.72
214	0600	11/22	10°37'S	141°40'W	82.3	080	12	83.0	76.3	1012	02	X	3	9	2	060	1	35.84	0.30
215	1200	11/22	10°04'S	141°08'W	82.5	080	11	81.9	76.0	1011	02	X	4	5	2	050	1	35.85	0.29
216	1800	11/22	09°28'S	140°35'W	82.0	070	13	81.0	76.2	1013	02	8,6	3	9	2	050	1	35.79	0.29
217	2120	11/24	08°21'S	140°38'W	82.1	040	18	83.1	76.9	1011	03	8,6	8	7	2	050	3	-	-
218	2328	11/24	08°12'S	140°41'W	82.5	040	13	83.1	76.5	1009	01	8,6	6	7	2	050	3	-	-
219	2045	11/25	07°52'S	140°10'W	82.1	060	16	82.1	75.1	1011	01	8	2	9	3	060	1	-	-
220	0000	11/26	08°01'S	139°44'W	81.9	060	14	81.9	75.4	1009	02	8	3	9	3	060	1	35.75	0.34
221	2120	11/26	08°51'S	139°13'W	82.6	050	12	84.5	77.0	1011	02	8	3	9	2	060	1	-	-
222	0030	11/27	08°59'S	139°30'W	82.1	070	17	82.5	76.0	1009	02	8	3	9	2	070	1	35.70	0.36
223	2115	11/27	09°42'S	138°47'W	82.6	040	14	82.6	75.5	1011	02	8	3	9	2	040	1	-	-
224	2125	11/28	10°00'S	138°51'W	83.5	050	05	82.2	75.6	1010	01	8	4	9	1	000	0	-	-
225	2330	11/28	10°08'S	138°50'W	82.8	100	09	84.0	76.8	1010	03	8	6	9	1	120	1	-	-
226	2045	11/29	10°02'S	139°09'W	83.4	100	04	84.5	76.0	1010	02	8	3	9	1	140	1	-	-
227	2130	11/30	09°38'S	139°41'W	83.4	050	11	83.1	76.8	1010	02	8	4	9	2	080	1	-	-
228	0000	12/1	09°24'S	139°56'W	83.1	050	10	82.9	76.2	1008	01	8	2	9	1	060	1	35.71	0.36
229	1500	12/1	09°34'S	139°49'W	81.4	080	09	81.4	75.0	1009	02	8	2	9	1	060	1	-	-
230	1800	12/1	09°33'S	139°51'W	81.5	060	07	82.9	75.1	1011	02	8	2	9	1	060	1	-	-
231	2100	12/1	09°34'S	139°52'W	83.1	070	07	83.3	75.5	1010	02	8	2	9	1	070	1	-	-
232	0000	12/2	09°34'S	139°50'W	83.5	040	07	83.5	76.2	1008	02	8	2	9	1	080	1	-	-
233	0300	12/2	09°34'S	139°50'W	83.9	080	09	82.5	76.0	1010	03	8	4	9	1	080	1	-	-
234	0600	12/2	09°34'S	139°50'W	82.0	070	09	81.1	75.7	1012	03	8,6	4	9	1	080	1	-	-
235	0900	12/2	09°31'S	139°52'W	81.7	090	10	80.9	74.5	1012	03	8,6	7	9	1	090	1	-	-
236	1200	12/2	09°34'S	139°52'W	81.8	030	12	81.0	75.9	1010	01	8,6	2	9	1	080	1	-	-
237	1800	12/4	07°54'S	140°42'W	82.0	090	18	82.5	76.0	1014	03	8,4	4	9	1	090	1	35.64	0.43
238	2100	12/4	07°30'S	140°54'W	82.5	070	14	82.5	76.0	1012	03	8,5	6	9	1	090	1	-	-
239	0000	12/5	07°08'S	141°08'W	82.2	050	13	83.0	76.0	1010	02	8,5	7	9	1	050	1	35.68	0.29
240	0300	12/5	06°46'S	141°22'W	82.4	050	13	82.4	75.9	1011	02	8,4	7	9	2	050	1	-	-
241	0600	12/5	06°24'S	141°37'W	81.8	060	13	82.0	76.0	1013	01	8	2	9	2	060	1	35.64	0.37
242	0900	12/5	06°02'S	141°52'W	81.9	060	14	81.3	76.0	1013	02	8	2	9	2	060	1	-	-
243	1200	12/5	05°42'S	142°04'W	81.3	050	17	81.1	76.2	1011	03	8	5	7	2	060	1	35.64	0.36
244	1500	12/5	05°20'S	142°19'W	81.2	050	16	81.2	76.0	1012	02	8,4	6	8	2	050	1	-	-
245	1800	12/5	04°55'S	142°30'W	81.5	090	19	82.2	76.6	1014	02	8,4	4	9	3	060	1	35.62	0.42

Table 2.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
246	2100	12/5	04°32'S	142°44'W	82.2	090	20	82.2	76.5	1013	02	8	4	9	3	080	1	-	-
247	0000	12/6	04°11'S	142°58'W	82.3	080	13	82.5	76.5	1010	02	8,5	6	9	2	070	1	35.62	0.44
248	0300	12/6	03°50'S	143°11'W	82.1	080	12	82.1	76.8	1011	02	8,5	5	8	2	070	1	-	-
249	0600	12/6	03°27'S	143°21'W	81.9	060	15	82.2	76.5	1012	01	8	2	9	2	070	1	35.52	0.34
250	0900	12/6	03°02'S	143°30'W	82.0	060	13	82.0	77.0	1014	02	8,6	2	9	2	070	1	-	-
251	1200	12/6	02°38'S	143°38'W	81.8	070	13	81.8	76.0	1012	02	8	4	7	2	070	1	35.50	0.42
252	1500	12/6	02°14'S	143°47'W	81.8	070	15	81.8	76.0	1012	03	8,5	6	8	2	070	1	-	-
253	1800	12/6	01°50'S	143°56'W	82.1	080	16	83.0	77.0	1014	02	8	4	9	3	090	1	35.35	0.37
254	2100	12/6	01°26'S	144°05'W	83.0	070	15	83.2	76.8	1013	02	8	4	9	3	090	1	-	-
255	0000	12/7	01°02'S	144°15'W	83.0	090	16	83.2	77.0	1011	03	8,5	6	9	3	090	1	35.34	0.37
256	0300	12/7	00°38'S	144°27'W	81.8	150	16	80.2	75.5	1012	15	8,5	7	9	3	130	1	-	-
257	0600	12/7	00°15'S	144°38'W	81.8	130	07	78.0	77.1	1014	21	8,6	8	5	3	130	1	35.12	0.35
258	0900	12/7	00°08'N	144°49'W	81.7	120	11	81.5	77.5	1014	02	8,6	6	8	3	130	1	-	-
259	1200	12/7	00°27'N	144°59'W	81.9	130	14	81.9	76.1	1012	01	8,6	4	7	3	130	1	35.03	0.33
260	1500	12/7	00°48'N	145°12'W	82.0	120	16	81.4	76.1	1013	01	8,1	4	8	2	130	1	-	-
261	1800	12/7	01°09'N	145°26'W	82.3	140	14	83.2	76.0	1014	03	8,4	6	8	3	140	1	35.03	0.23
262	2100	12/7	01°30'N	145°40'W	83.0	130	11	84.8	77.9	1013	02	8,4	6	8	3	140	1	-	-
263	0000	12/8	01°52'N	145°54'W	83.1	120	13	82.9	77.0	1011	02	8,4	5	9	3	130	1	35.03	0.42
264	0300	12/8	02°14'N	146°09'W	82.5	130	11	82.9	77.1	1012	02	8,4	4	9	2	130	1	-	-
265	0600	12/8	02°36'N	146°24'W	82.0	130	09	83.0	77.5	1014	02	8,4	6	9	3	130	1	35.01	0.39
266	0900	12/8	02°58'N	146°39'W	82.2	130	08	84.8	78.0	1014	02	8	4	9	3	130	1	-	-
267	1200	12/8	03°19'N	146°52'W	82.5	110	10	81.5	76.8	1012	15	8,5	6	7	2	130	1	35.05	0.35
268	1500	12/8	03°42'N	147°08'W	82.0	110	09	81.8	77.2	1012	15	8,5	6	7	2	130	1	-	-
269	1800	12/8	04°05'N	147°23'W	82.0	120	10	78.8	76.3	1014	21	8,5	8	7	2	130	1	35.10	0.44
270	2100	12/8	04°28'N	147°38'W	82.5	100	10	83.0	77.0	1013	01	8,5	6	8	2	100	2	-	-
271	0000	12/9	04°50'N	147°50'W	82.9	090	05	82.1	77.9	1010	03	8,5	8	8	2	110	1	35.12	0.38
272	0300	12/9	05°14'N	148°02'W	82.8	060	09	81.8	77.5	1010	02	8,5	7	8	2	070	1	-	-
273	0600	12/9	05°37'N	148°12'W	82.2	070	07	82.0	77.2	1012	01	6,8	6	9	2	040	1	-	-
274	0900	12/9	06°00'N	148°24'W	83.0	060	06	82.2	76.0	1012	01	8	3	9	2	040	1	-	-
275	1200	12/9	06°21'N	148°34'W	83.5	050	07	81.5	75.5	1010	02	8	4	7	2	060	1	-	-
276	1500	12/9	06°44'N	148°46'W	83.4	090	06	81.3	75.1	1010	02	8	4	7	2	060	1	-	-
277	1800	12/9	07°07'N	148°57'W	82.8	060	06	83.5	76.0	1012	02	8,4,1	4	9	2	060	2	-	-
278	2100	12/9	07°30'N	149°08'W	83.8	060	09	82.8	76.0	1011	02	8,4,1	4	9	2	060	2	-	-
279	0000	12/10	07°53'N	149°22'W	83.5	060	12	80.5	77.1	1009	16	8,4	7	8	2	020	2	-	-
280	0300	12/10	08°16'N	149°36'W	82.9	070	14	80.9	76.9	1010	16	8,4	7	8	3	050	2	-	-

Table 2. --Observations at bathythermograph lowerings, Charles H. Gilbert cruise 35 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1957	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
281	0600	12/10	08°39'N	149°51'W	82.1	060	16	81.0	76.5	1011	00	X	X	8	3	060	2	-	-
282	0900	12/10	09°03'N	150°06'W	81.8	060	15	81.8	76.5	1012	02	8,6	6	8	3	060	4	-	-
283	1200	12/10	09°24'N	150°19'W	82.0	060	13	81.0	76.4	1010	02	8,5	5	5	3	050	4	-	-
284	1500	12/10	09°48'N	150°34'W	81.0	070	16	81.0	76.5	1011	02	8,4	7	5	3	060	4	-	-
285	1800	12/10	10°11'N	150°48'W	80.5	070	15	81.2	76.5	1013	03	8,4	8	7	2	020	4	-	-
286	2100	12/10	10°36'N	151°03'W	81.8	060	15	82.0	77.0	1012	02	8	6	7	2	030	4	-	-
287	0000	12/11	10°57'N	151°18'W	80.9	080	16	81.1	77.3	1010	02	8,4	6	9	3	030	4	-	-
288	0300	12/11	11°18'N	151°34'W	80.5	080	13	80.7	77.3	1010	02	8,5	7	8	3	050	4	-	-
289	0600	12/11	11°39'N	151°51'W	80.0	080	17	81.5	76.0	1012	00	X	X	9	3	050	4	-	-
290	0900	12/11	12°02'N	152°08'W	80.0	070	19	80.5	77.0	1014	02	8	4	9	3	050	4	-	-
291	1200	12/11	12°21'N	152°23'W	80.1	060	19	80.1	76.1	1011	02	4,8	7	7	3	040	4	-	-
292	1800	12/11	13°06'N	152°57'W	79.8	060	18	80.0	76.0	1012	02	8,4	6	9	2	050	4	-	-
293	0000	12/12	13°50'N	153°30'W	30.1	050	17	80.1	76.0	1011	03	8,5	7	9	2	050	4	-	-
294	0600	12/12	14°35'N	153°56'W	79.2	060	22	79.0	74.0	1014	00	X	X	8	2	050	4	-	-
295	1200	12/12	15°20'N	154°22'W	77.9	040	24	77.0	73.0	1013	03	8	8	5	4	050	4	-	-
296	No slide																		
297	0000	12/13	16°49'N	155°16'W	77.8	050	22	76.5	69.1	1012	02	8,4	8	6	5	050	4	-	-

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
1	2100	1/3	21°26'N	158°16'W	76.0	340	21	75.3	66.7	1019	80	8	6	8	4	340	4	34.76	-
2	2335	1/3	21°25'N	158°39'W	75.5	010	21	75.5	65.5	1016	01	8	2	8	4	350	4	34.74	-
3	0225	1/4	21°25'N	159°00'W	74.7	350	29	73.0	63.0	1016	02	8	2	8	5	350	4	34.79	-
4	0415	1/4	21°35'N	159°00'W	74.3	360	25	70.5	63.5	1017	03	8	6	7	5	350	4	34.78	-
5	0645	1/4	21°35'N	158°42'W	74.0	010	25	68.2	63.0	1018	03	X	X	5	6	320	6	34.85	-
6	0845	1/4	21°35'N	158°24'W	74.2	360	31	69.3	63.3	1019	02	X	X	7	6	XXX	X	34.74	-
7	1400	1/4	21°52'N	157°58'W	72.8	360	26	67.8	59.6	1017	02	8	6	7	5	350	4	34.76	-
8	1620	1/4	22°04'N	158°00'W	72.7	350	23	68.7	60.3	1019	02	X	X	7	5	350	4	34.78	-
9	1855	1/4	22°20'N	158°02'W	72.7	340	29	66.2	61.2	1019	80	8	8	6	5	340	4	35.14	-
10	2015	1/4	22°18'N	157°53'W	72.5	350	22	68.3	60.0	1021	02	8	7	7	5	350	4	35.14	-
11	2240	1/4	21°56'N	157°58'W	73.1	360	21	69.0	61.0	1017	02	4,8	7	7	5	350	4	35.19	-
12	0200	1/5	21°36'N	157°46'W	73.5	360	19	70.0	60.8	1017	15	8	7	7	4	330	4	35.10	-
13	1815	1/5	19°30'N	156°36'W	74.8	030	20	72.0	65.0	1018	01	4,8	3	8	3	340	3	-	-
14	0000	1/6	18°43'N	156°08'W	76.4	360	07	73.8	66.4	1016	02	4,8	3	8	2	340	1	-	-
15	0600	1/6	18°05'N	155°46'W	75.5	060	19	73.9	65.4	1017	03	X	X	7	3	020	1	-	-
16	1200	1/6	17°18'N	155°15'W	75.9	030	21	73.7	65.7	1018	80	4,8	4	7	3	350	X	-	-
17	1800	1/6	16°33'N	154°47'W	76.0	050	15	71.2	67.5	1018	01	4,8	6	7	3	050	2	-	-
18	0000	1/7	15°48'N	154°22'W	76.2	070	15	74.6	68.6	1016	01	8	4	7	3	020	2	-	-
19	0600	1/7	15°03'N	153°57'W	77.1	060	19	75.5	68.7	1017	01	8	2	7	3	040	1	-	-
20	1200	1/7	14°26'N	153°31'W	76.9	060	16	75.8	70.6	1016	15	8,4	5	7	3	030	1	-	-
21	1800	1/7	13°40'N	153°02'W	77.3	040	17	76.3	71.8	1016	01	0,6	2	7	4	040	1	-	-
22	0000	1/8	12°58'N	152°32'W	78.5	070	17	77.4	72.2	1013	03	6,8	3	7	4	030	1	-	-
23	0600	1/8	12°13'N	152°12'W	78.6	060	18	78.2	73.8	1014	01	X	X	6	4	060	1	-	-
24	1200	1/8	11°35'N	151°53'W	78.3	080	16	78.2	74.0	1013	01	8	2	7	3	050	1	-	-
25	1800	1/8	10°51'N	151°32'W	78.5	070	18	79.0	74.0	1014	01	4,8	3	7	4	070	1	-	-
26	2100	1/8	10°32'N	151°22'W	79.0	080	19	79.0	73.8	1014	01	8	2	7	4	070	1	-	-
27	0000	1/9	10°06'N	151°10'W	79.3	070	18	79.7	73.8	1010	02	1	2	7	4	060	1	-	-
28	0300	1/9	09°44'N	150°58'W	79.9	070	18	79.8	74.8	1011	03	8,9	3	7	4	070	1	-	-
29	0600	1/9	09°24'N	150°46'W	80.5	070	19	80.3	75.1	1012	01	X	X	7	4	070	1	-	-
30	0900	1/9	09°08'N	150°34'W	80.8	070	21	80.4	74.7	1012	02	X	X	7	4	070	1	-	-
31	1200	1/9	08°47'N	150°21'W	79.2	080	19	79.5	74.0	1011	03	4	7	7	4	070	1	-	-
32	1500	1/9	08°26'N	150°08'W	81.2	070	19	80.0	73.1	1012	01	8	2	7	4	070	1	-	-
33	1800	1/9	08°06'N	149°53'W	81.4	070	24	81.0	74.0	1012	01	4,8	3	7	5	070	1	-	-
34	2100	1/9	07°46'N	149°38'W	81.8	060	24	81.2	74.8	1012	03	1,8	4	7	5	070	3	-	-
35	0000	1/10	07°25'N	149°23'W	82.3	060	18	81.6	75.7	1010	03	8,4,2	6	7	5	070	3	-	-

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
36	0300	1/10	07°04'N	149°12'W	82.4	050	20	81.9	75.5	1010	03	2,4,8	7	7	3	070	3	-	-
37	0600	1/10	06°42'N	149°00'W	81.7	040	19	81.8	76.8	1011	03	8	7	7	4	070	3	-	-
38	0900	1/10	06°28'N	148°48'W	82.3	030	23	81.8	76.7	1012	02	X	X	7	4	070	3	-	-
39	1200	1/10	06°06'N	148°36'W	82.8	030	20	78.3	77.3	1010	25	X	9	5	3	070	3	-	-
40	1500	1/10	05°45'N	148°24'W	82.8	040	17	79.2	77.8	1011	80	X	9	5	3	070	1	-	-
41	1800	1/10	05°25'N	148°12'W	82.3	080	19	77.2	75.5	1013	63	0,8	8	4	3	070	3	-	-
42	2100	1/10	05°04'N	147°58'W	82.5	050	10	78.1	77.0	1012	80	0,8	8	5	3	070	3	34.45	0.13
43	0000	1/11	04°44'N	147°47'W	82.5	040	18	79.0	77.0	1010	02	0,8	8	5	3	070	3	-	-
44	0300	1/11	04°22'N	147°34'W	83.0	080	16	81.5	78.2	1010	02	0,8	8	5	3	070	3	34.78	0.18
45	0600	1/11	04°00'N	147°21'W	82.4	100	18	83.1	77.0	1011	02	0,8	8	5	3	110	3	-	-
46	0900	1/11	03°44'N	147°12'W	83.0	120	19	82.7	77.3	1012	01	X	X	5	3	XXX	X	34.99	0.14
47	1200	1/11	03°24'N	147°00'W	82.4	120	17	82.1	76.2	1010	00	X	X	5	3	XXX	X	-	-
48	1500	1/11	03°03'N	146°48'W	82.0	130	18	82.0	76.5	1010	03	6,8	7	5	3	110	1	34.99	0.11
49	1800	1/11	02°42'N	146°36'W	82.3	130	17	82.4	77.3	1012	00	6	8	6	3	110	1	-	-
50	2100	1/11	02°22'N	146°23'W	82.5	110	17	83.2	77.5	1012	02	0,1,4,8	7	7	3	110	1	34.94	0.21
51	0000	1/12	02°02'N	146°12'W	82.6	120	15	82.7	76.0	1009	02	1,4,8	7	7	3	110	1	-	-
52	0300	1/12	01°42'N	146°05'W	82.4	120	14	82.5	76.6	1009	01	1,8	3	7	3	110	1	35.05	0.23
53	0600	1/12	01°22'N	145°55'W	82.0	110	19	81.8	77.0	1011	01	X	2	6	3	120	1	-	-
54	0915	1/12	01°02'N	145°47'W	81.4	110	16	81.3	75.5	1011	00	X	X	X	8	XXX	X	35.17	0.18
55	1200	1/12	00°41'N	145°38'W	81.6	110	18	81.0	75.5	1010	00	X	X	X	8	XXX	X	-	-
56	1500	1/12	00°20'N	145°28'W	81.7	110	11	80.7	75.3	1010	01	2,8	2	7	3	120	1	35.28	0.43
57	1800	1/12	00°04'S	145°18'W	81.9	100	14	82.4	76.3	1012	03	1,8	5	7	3	090	1	-	-
58	2100	1/12	00°28'S	145°08'W	81.5	110	17	82.3	76.0	1010	02	1,8	2	7	3	110	1	35.34	0.32
59	0000	1/13	00°50'S	144°56'W	82.2	110	17	82.5	75.7	1008	02	1,8	2	7	3	090	1	-	-
60	0300	1/13	01°12'S	144°44'W	82.3	090	12	82.5	76.0	1090	03	1,8	3	7	3	090	1	35.37	0.17
61	0600	1/13	01°35'S	144°32'W	82.2	110	11	81.7	75.8	1010	01	X	2	6	3	110	1	-	-
62	0900	1/13	01°53'S	144°22'W	82.3	100	10	81.8	76.3	1011	02	X	X	7	3	110	1	35.37	0.31
63	1200	1/13	02°15'S	144°09'W	82.2	110	11	81.2	76.0	1010	02	X	X	7	3	110	1	-	-
64	1500	1/13	02°38'S	143°57'W	82.3	110	10	81.5	76.5	1010	02	2,8,9	2	7	2	110	1	35.48	0.30
65	1800	1/13	03°00'S	143°45'W	82.2	130	14	82.6	76.6	1012	02	8,1	3	7	2	100	1	-	-
66	2100	1/13	03°22'S	143°33'W	82.8	120	12	81.8	75.5	1010	02	8	2	7	2	110	1	35.46	0.52
67	0000	1/14	03°45'S	143°19'W	83.1	090	12	82.5	76.5	1009	02	8	2	7	3	100	1	-	-
68	0300	1/14	04°09'S	143°04'W	83.0	090	12	82.2	76.2	1009	02	8	2	7	3	100	1	35.43	0.42
69	0600	1/14	04°32'S	142°49'W	82.8	090	11	82.1	76.5	1010	02	X	2	7	3	110	1	-	-
70	0900	1/14	04°51'S	142°36'W	82.4	110	10	81.8	76.5	1012	02	X	X	7	3	110	1	35.62	0.10

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
71	1200	1/14	05°17'S	142°20'W	82.4	110	08	81.5	76.2	1010	00	X	X	7	3	110	1	-	-
72	1500	1/14	05°39'S	142°05'W	82.3	080	09	81.5	76.0	1010	02	8	2	7	2	100	1	35.66	0.38
73	1800	1/14	06°05'S	141°52'W	82.7	070	11	83.5	77.4	1012	02	1	2	7	2	110	1	-	-
74	2100	1/14	06°30'S	141°39'W	83.0	080	09	82.8	76.8	1011	02	8	2	8	2	100	1	35.70	0.30
75	0000	1/15	06°56'S	141°27'W	83.4	070	11	82.8	76.8	1009	02	8	2	8	2	100	1	-	-
76	0300	1/15	07°23'S	141°14'W	82.8	060	11	82.8	76.8	1010	02	8	2	8	2	100	1	35.66	0.30
77	0600	1/15	07°47'S	141°02'W	82.8	070	11	82.8	76.8	1012	02	X	2	7	2	100	1	-	-
78	0900	1/15	08°13'S	140°47'W	82.8	080	09	82.2	76.5	1012	02	X	X	8	2	XXX	X	35.61	0.27
79	1200	1/15	08°38'S	140°29'W	82.8	070	11	82.0	76.2	1010	00	X	X	7	2	XXX	X	-	-
80	2015	1/18	08°34'S	140°38'W	83.7	050	18	85.6	78.6	1008	03	2, 1, 8	6	8	3	080	1	-	-
81	2100	1/18	08°30'S	140°40'W	83.8	050	18	86.0	78.8	1008	03	2, 8	6	8	3	080	1	35.75	0.26
82	0125	1/19	08°05'S	140°45'W	84.0	060	13	87.7	77.8	1005	01	2, 1, 8	5	8	3	080	1	-	-
83	2110	1/19	07°51'S	140°14'W	82.8	040	14	82.7	76.5	1008	02	8, 5	4	8	4	070	1	35.70	0.09
84	2110	1/20	08°53'S	139°12'W	83.1	040	15	85.2	77.0	1008	01	2, 8	6	8	4	070	1	35.70	0.30
85	2015	1/21	09°22'S	138°58'W	83.5	060	16	84.5	77.3	1011	01	2, 8	3	8	3	070	1	35.71	-
86	2200	1/21	09°29'S	138°52'W	83.4	060	14	85.4	76.2	1010	01	8, 5	2	8	3	070	1	35.79	0.21
87	2040	1/22	10°04'S	138°53'W	83.3	040	12	84.2	76.3	1012	03	8, 2	6	9	3	080	2	-	-
88	2100	1/23	09°58'S	139°24'W	83.5	020	11	85.3	77.0	1014	15	0, 2, 5, 8	6	7	2	030	1	35.75	0.30
89	0115	1/24	09°35'S	139°51'W	84.2	040	07	83.2	76.2	1011	03	0, 4, 8	7	8	2	080	1	-	-
90	0315	1/24	09°32'S	139°50'W	83.8	060	10	82.9	76.5	1012	02	6, 8	6	8	2	080	1	-	-
91	0500	1/24	09°35'S	139°50'W	83.7	060	08	85.0	77.8	1013	02	X	X	6	1	080	1	-	-
92	0700	1/24	09°34'S	139°50'W	83.4	060	08	83.4	76.7	1013	02	X	X	6	2	080	1	-	-
93	0900	1/24	09°34'S	139°50'W	83.2	050	09	82.6	75.4	1013	02	X	X	6	2	080	1	-	-
94	1100	1/24	09°34'S	139°50'W	84.5	070	10	84.0	77.8	1012	02	X	X	6	2	080	1	-	-
95	1300	1/24	09°34'S	139°49'W	83.3	070	12	80.5	75.8	1012	00	X	X	6	2	080	1	-	-
96	1500	1/24	09°34'S	139°50'W	82.9	060	08	80.2	75.0	1012	03	6, 8	7	7	2	080	1	-	-
97	1700	1/24	09°34'S	139°50'W	83.6	030	05	82.1	76.8	1014	01	1, 8	6	7	2	080	1	-	-
98	1900	1/24	09°34'S	139°50'W	83.7	050	13	84.0	77.5	1013	02	1, 6, 8	6	7	3	060	1	-	-
99	2100	1/24	09°34'S	139°50'W	84.1	040	10	85.0	77.8	1013	01	1, 2, 8	4	7	2	070	1	35.82	0.17
100	2300	1/24	09°34'S	139°50'W	84.5	050	08	86.0	78.1	1011	02	1, 8	4	7	2	080	1	-	-
101	1810	1/25	09°09'S	140°08'W	83.9	080	08	84.0	76.8	1012	01	1, 8	5	7	2	080	1	-	-
102	0300	1/28	09°12'S	139°38'W	83.8	070	12	84.6	77.2	1010	01	1, 2, 8	6	9	3	090	2	35.79	0.19
103	0600	1/28	09°12'S	139°17'W	83.8	090	14	84.0	76.9	1012	00	X	X	6	3	090	2	35.82	0.23
104	0900	1/28	09°12'S	139°02'W	83.3	080	18	78.6	75.3	1012	81	X	X	5	3	090	2	35.86	0.19
105	1200	1/28	09°12'S	138°48'W	83.3	090	15	82.8	76.2	1010	00	X	X	5	3	090	2	35.84	0.40

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
106	1500	1/28	09°12'S	138°28'W	82.8	070	14	82.5	76.7	1010	00	8,5,1	3	7	3	080	2	35.79	0.20
107	1800	1/28	09°15'S	138°06'W	83.0	060	17	83.0	77.0	1012	02	4,6	6	7	3	080	2	35.82	0.28
108	2100	1/28	09°18'S	137°50'W	83.1	070	16	81.8	76.8	1011	03	4,6	7	7	3	080	2	35.77	0.30
109	0000	1/29	09°20'S	137°28'W	83.2	080	10	83.4	76.7	1010	15	4,8,3	6	7	3	090	2	35.71	0.29
110	0115	1/29	09°17'S	137°25'W	83.2	080	11	84.8	77.3	1009	01	4,8	5	7	3	090	2	-	-
111	0300	1/29	09°12'S	137°11'W	83.1	120	13	82.8	77.6	1010	02	8,6,2	5	7	3	090	2	35.75	0.21
112	0600	1/29	09°10'S	136°50'W	83.0	080	14	82.5	77.3	1011	00	X	X	6	3	080	3	35.73	0.35
113	0900	1/29	09°10'S	136°33'W	83.0	150	10	82.4	76.2	1011	00	X	X	6	3	080	3	35.71	0.19
114	1200	1/29	09°10'S	136°18'W	82.7	080	10	81.0	76.5	1010	00	X	X	6	3	080	3	35.71	0.28
115	1500	1/29	09°10'S	136°00'W	82.2	360	12	79.5	75.6	1011	00	6,4,8	8	6	3	070	2	35.70	0.13
116	1800	1/29	09°10'S	136°25'W	82.8	010	11	82.0	77.3	1011	02	4,6,8	6	7	2	080	2	35.71	0.31
117	2100	1/29	09°10'S	136°44'W	83.9	040	08	87.0	78.8	1012	01	4,6	4	7	2	080	2	35.70	0.38
118	0000	1/30	09°09'S	137°06'W	82.8	110	27	77.6	74.7	1011	61	0	8	5	4	090	3	35.71	0.19
119	0300	1/30	09°12'S	137°08'W	82.2	110	32	81.0	75.3	1011	01	0,4,3	7	6	5	120	4	35.71	0.21
120	0600	1/30	09°12'S	137°29'W	82.7	090	26	83.0	76.0	1010	02	X	X	6	5	120	4	35.75	0.28
121	0900	1/30	09°12'S	137°49'W	83.2	030	14	82.9	77.3	1010	02	X	7	5	4	120	4	35.71	0.42
122	1200	1/30	09°12'S	138°10'W	83.0	090	15	83.5	77.0	1009	00	X	X	6	4	120	4	35.73	0.22
123	1500	1/30	09°12'S	138°31'W	83.3	110	09	82.5	77.5	1011	15	4,8,3	5	7	2	150	4	35.71	0.18
124	1800	1/30	09°12'S	138°56'W	83.5	160	10	82.7	77.0	1012	15	8,6,4,5	7	7	2	130	4	35.82	0.31
125	2100	1/30	09°12'S	139°21'W	83.8	050	16	83.2	78.0	1013	02	4	8	7	3	080	4	35.81	0.30
126	0000	1/31	09°09'S	139°36'W	83.9	030	06	82.0	77.1	1011	15	0,8,5	7	7	3	100	4	35.82	0.17
127	0200	1/31	09°05'S	139°36'W	83.8	090	12	82.0	77.2	1010	01	2,5	5	7	3	100	4	-	-
128	0300	1/31	09°12'S	139°38'W	83.5	090	12	81.6	76.3	1011	01	2,4,8	2	8	3	100	4	35.68	0.14
129	0600	1/31	09°37'S	139°40'W	83.8	060	16	81.5	77.0	1012	00	X	X	6	3	100	4	35.81	0.28
130	0900	1/31	09°55'S	139°40'W	83.4	070	12	81.6	77.2	1012	00	X	X	6	3	100	4	35.75	0.30
131	1200	1/31	10°14'S	139°38'W	83.5	080	14	81.6	76.2	1010	00	X	X	6	3	100	4	35.86	0.20
132	1500	1/31	10°30'S	139°38'W	83.3	090	12	82.1	77.4	1012	00	8	2	7	2	100	4	35.82	0.20
133	1800	1/31	10°54'S	139°40'W	83.5	090	16	83.6	78.5	1012	01	8	5	7	3	100	4	35.86	0.33
134	2100	1/31	11°16'S	139°43'W	83.5	090	18	83.8	77.2	1011	01	1,8	4	7	3	100	4	-	0.12
135	0000	2/1	11°36'S	139°45'W	83.9	080	20	83.6	77.7	1010	02	8,1	5	7	4	090	4	-	0.15
136	0300	2/1	11°58'S	139°46'W	83.8	080	17	83.5	78.3	1010	01	8,1	2	7	3	090	4	35.88	0.18
137	0600	2/1	12°02'S	139°36'W	84.0	060	16	83.5	77.3	1011	01	8	2	6	3	070	4	35.86	0.17
138	0900	2/1	12°20'S	139°36'W	83.5	080	12	83.1	76.7	1012	02	8	2	6	3	080	4	35.97	0.19
139	1200	2/1	12°31'S	139°34'W	83.6	080	15	82.5	76.4	1010	00	X	X	6	3	080	4	35.91	0.19
140	1500	2/1	12°52'S	139°32'W	83.4	090	09	82.2	76.1	1012	03	1,8	5	7	3	090	4	35.91	0.18

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
141	1800	2/1	12°42'S	139°40'W	83.8	080	15	84.5	77.2	1012	01	1,8	4	7	3	080	4	35.95	0.20
142	1905	2/1	12°31'S	139°40'W	84.0	100	17	85.3	79.4	1012	03	4,8	6	7	3	080	4	-	-
143	2100	2/1	12°16'S	139°40'W	84.1	080	12	86.0	78.0	1011	01	4,8	3	7	3	080	4	35.86	0.18
144	0000	2/2	11°55'S	139°39'W	84.0	060	12	88.1	78.5	1010	03	2,1,8	6	7	3	080	4	35.93	0.20
145	0300	2/2	11°37'S	139°42'W	84.0	060	14	85.0	76.3	1010	01	8	2	7	3	060	4	35.97	0.18
146	0600	2/2	11°16'S	139°42'W	83.9	060	10	85.0	77.2	1011	03	8	3	6	3	060	4	36.00	0.19
147	0900	2/2	11°02'S	139°41'W	84.0	060	12	83.7	77.4	1012	01	8	2	6	3	060	4	35.84	0.07
148	1200	2/2	10°43'S	139°39'W	84.0	070	12	83.2	77.0	1010	02	8	2	6	3	070	4	35.82	0.22
149	1500	2/2	10°27'S	139°38'W	83.0	070	11	82.1	77.3	1011	02	8	2	6	2	070	4	35.88	0.20
150	1800	2/2	10°02'S	139°39'W	83.9	050	12	84.0	77.2	1012	03	4,8	3	7	2	070	4	35.82	0.30
151	2100	2/2	09°36'S	139°40'W	83.7	080	14	82.7	76.5	1012	15	6,4,8	7	8	3	050	4	35.81	-
152	0000	2/3	09°13'S	139°40'W	84.3	070	13	85.7	78.6	1010	02	8,2,6,5	4	9	2	070	2	35.73	-
153	1500	2/5	09°12'S	139°39'W	XXX	090	14	83.1	77.0	1011	01	1,8	2	9	2	090	2	-	-
154	1800	2/5	09°12'S	140°03'W	83.0	100	18	82.7	76.4	1012	00	8,1	3	8	3	090	3	-	0.28
155	2100	2/5	09°12'S	140°30'W	83.8	080	16	87.6	77.8	1011	01	8,1	2	9	3	090	3	35.77	0.20
156	0000	2/6	09°11'S	140°48'W	84.1	090	21	85.0	77.3	1009	02	1,8	2	9	3	090	3	35.84	0.22
157	0300	2/6	09°06'S	140°48'W	84.0	090	18	86.0	79.0	1009	03	1,8	3	9	3	090	3	35.86	0.19
158	0600	2/6	09°07'S	141°05'W	83.9	090	20	83.4	76.8	1010	02	X	X	7	3	100	3	35.75	0.10
159	0900	2/6	09°07'S	141°21'W	84.0	090	18	84.0	78.2	1010	00	X	X	7	3	090	3	35.84	0.23
160	1200	2/6	09°08'S	141°32'W	83.9	110	18	83.3	76.9	1010	02	8,1	3	7	3	100	3	35.81	0.23
161	1500	2/6	09°08'S	141°48'W	84.0	130	19	83.2	77.8	1010	01	1,8	3	7	3	130	3	35.86	0.17
162	1815	2/6	09°07'S	142°12'W	84.0	090	17	85.4	78.5	1012	03	8	4	7	3	100	3	35.79	0.20
163	2100	2/6	09°03'S	142°30'W	84.3	100	13	85.6	78.5	1011	01	8	3	7	3	100	3	35.79	0.11
164	0000	2/7	09°06'S	142°55'W	84.8	100	16	85.0	77.2	1008	01	8	3	7	3	100	3	35.75	0.30
165	0300	2/7	09°12'S	143°25'W	84.7	100	16	85.0	78.1	1008	02	8	3	7	3	100	3	35.77	0.20
166	0600	2/7	09°13'S	143°02'W	84.1	100	16	84.4	77.3	1010	00	X	X	7	3	100	3	35.71	0.19
167	0900	2/7	09°14'S	142°43'W	84.1	090	14	85.0	77.3	1010	00	X	X	6	3	090	3	35.68	0.30
168	1200	2/7	09°15'S	142°26'W	83.9	090	14	83.5	77.3	1010	00	X	X	7	3	090	3	35.68	0.22
169	1500	2/7	09°16'S	142°04'W	83.7	090	20	83.8	76.0	1010	02	1,8	3	7	3	090	3	35.77	0.22
170	1800	2/7	09°15'S	141°43'W	83.9	100	21	84.2	77.6	1010	02	8	3	7	4	090	4	35.79	0.23
171	2100	2/7	09°14'S	141°24'W	84.1	100	18	85.5	77.7	1008	01	8,1	1	7	4	090	4	35.77	0.17
172	0000	2/8	09°12'S	141°16'W	84.0	080	18	85.3	78.8	1006	03	8	4	7	4	090	4	35.81	0.19
173	0300	2/8	09°12'S	141°00'W	84.0	090	18	84.8	78.3	1007	02	8	4	7	4	090	4	35.86	0.11
174	0600	2/8	09°13'S	140°41'W	83.7	090	16	83.7	77.7	1008	00	X	X	7	4	090	4	35.88	0.05
175	0900	2/8	09°14'S	140°24'W	84.0	090	16	84.0	78.5	1009	00	X	X	7	4	090	4	35.82	0.40

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind Dir., °T.	Wind Force, kt.	Air temp. Dry bulb, °F.	Air temp. Wet bulb, °F.	Barometer, mb.	Weather	Clouds Type	Clouds Cover	Visibility	Sea	Swell Dir. °T.	Swell Amt.	Surf. sal., ‰	Surf. PO4-P, µg at./L.
176	1200	2/8	09°16'S	140°06'W	83.2	110	17	83.4	77.5	1008	00	8, 3	3	7	3	090	4	35.84	0.13
177	1500	2/8	09°13'S	139°46'W	83.5	080	18	82.8	77.0	1009	02	8	3	7	3	080	4	35.77	0.17
178	1500	2/9	09°12'S	139°38'W	83.0	070	15	82.5	77.2	1009	02	8	4	7	2	070	3	35.79	0.30
179	1650	2/9	08°56'S	139°40'W	83.2	070	15	84.0	77.3	1010	01	8	3	7	2	070	3	-	-
180	1800	2/9	08°46'S	139°40'W	83.2	080	17	83.7	77.4	1010	02	8	3	8	2	080	1	35.79	0.38
181	2100	2/9	08°17'S	139°40'W	83.5	090	18	85.6	79.3	1008	03	8	5	8	3	080	4	35.77	0.18
182	0000	2/10	07°58'S	139°40'W	84.0	080	17	86.5	78.0	1006	02	8	5	8	3	080	4	35.79	0.33
183	0300	2/10	07°57'S	139°41'W	83.7	080	16	85.0	78.1	1007	02	8	4	7	3	080	3	35.79	0.33
184	0600	2/10	07°35'S	139°40'W	83.3	070	20	83.7	77.9	1009	02	X	X	7	3	080	3	35.81	0.39
185	0900	2/10	07°17'S	139°39'W	83.4	060	16	84.0	78.0	1009	00	X	X	7	3	070	3	35.71	0.35
186	1200	2/10	06°55'S	139°40'W	83.1	070	13	82.6	77.6	1008	01	8	2	7	3	080	3	35.70	0.14
187	1500	2/10	06°36'S	139°39'W	82.8	070	14	82.8	78.2	1010	03	8	6	7	2	070	3	35.64	-
188	1800	2/10	06°12'S	139°36'W	82.8	090	18	84.4	78.6	1011	02	8	2	7	3	060	3	35.62	0.13
189	2100	2/10	05°56'S	139°28'W	83.1	090	14	85.8	78.5	1010	01	8	1	7	3	060	3	35.59	0.12
190	2340	2/10	05°58'S	139°44'W	83.3	090	12	85.6	78.7	1008	02	8	2	7	3	080	3	35.59	0.43
191	0400	2/11	05°18'S	139°50'W	83.0	080	15	84.0	79.0	1008	03	1, 8	3	7	3	080	3	35.50	0.18
192	0600	2/11	05°37'S	139°48'W	82.8	110	13	83.1	78.4	1010	80	X	X	7	3	080	3	-	0.26
193	0900	2/11	05°59'S	139°43'W	82.7	110	13	83.0	78.1	1010	00	X	X	7	3	110	3	35.52	0.40
194	1200	2/11	06°21'S	139°38'W	82.9	110	10	82.3	77.2	1009	03	4, 8	7	7	3	090	3	35.53	0.13
195	1500	2/11	06°42'S	139°34'W	82.2	110	12	82.5	78.2	1010	03	8	7	7	3	090	3	35.62	0.24
196	1800	2/11	07°06'S	139°34'W	83.2	080	14	84.5	78.3	1012	01	8	1	7	3	090	3	35.62	0.21
197	2100	2/11	07°28'S	139°34'W	83.7	100	11	84.7	78.7	1011	15	8, 6	3	7	2	090	3	35.70	0.43
198	0000	2/12	07°53'S	139°36'W	83.7	100	14	83.5	78.8	1009	13	6, 8	6	7	2	090	3	35.77	0.23
199	0330	2/12	08°14'S	139°39'W	84.1	130	14	83.8	79.5	1010	01	6, 8	3	7	3	090	3	35.77	0.21
200	0600	2/12	08°30'S	139°40'W	83.5	110	13	83.0	78.3	1011	00	X	X	7	3	090	3	35.77	0.20
201	0900	2/12	08°46'S	139°41'W	83.5	110	12	83.2	77.2	1011	00	X	X	6	3	090	3	35.79	0.18
202	1200	2/12	09°03'S	139°45'W	83.3	070	17	83.3	76.5	1010	01	1	8	7	3	090	3	35.81	0.19
203	0300	2/16	08°38'S	140°27'W	84.3	060	16	85.4	78.2	1003	01	8, 6	3	7	3	060	3	35.81	-
204	0600	2/16	08°19'S	140°39'W	84.0	070	15	85.0	78.6	1008	01	X	X	6	3	060	3	-	-
205	0900	2/16	07°56'S	140°56'W	84.2	080	17	85.0	78.8	1008	00	X	X	6	3	080	3	35.77	0.22
206	1200	2/16	07°35'S	141°09'W	83.8	070	17	83.3	77.8	1008	02	X	X	6	3	070	3	-	-
207	1500	2/16	07°13'S	141°23'W	83.8	090	22	83.1	77.2	1008	03	8	4	7	4	070	3	35.77	0.45
208	1800	2/16	06°48'S	141°36'W	83.7	090	19	84.3	77.5	1009	01	8	2	7	4	090	3	-	-
209	2100	2/16	06°23'S	141°49'W	83.6	100	22	85.0	77.0	1008	01	8	1	7	4	080	3	35.73	0.41
210	0000	2/17	05°58'S	142°02'W	83.7	080	17	85.3	76.5	1006	01	8	1	7	4	060	3	-	-

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
211	0300	2/17	05°35'S	142°15'W	83.4	080	15	85.4	77.3	1006	02	8	1	7	4	060	3	35.71	0.36
212	0600	2/17	05°16'S	142°25'W	83.1	090	18	83.7	77.0	1008	02	X	X	6	4	080	3	-	-
213	0900	2/17	04°53'S	142°38'W	82.8	130	14	84.0	77.8	1009	00	X	X	6	4	090	3	35.61	0.30
214	1200	2/17	04°30'S	142°52'W	82.8	100	17	82.5	77.2	1008	02	X	3	6	4	090	3	-	-
215	1500	2/17	04°06'S	143°05'W	82.7	110	15	82.8	77.6	1008	03	0,8	7	6	3	090	3	35.53	0.49
216	1830	2/17	03°40'S	143°20'W	82.8	130	13	84.5	77.8	1010	01	1,8	1	7	3	130	3	-	-
217	2100	2/17	03°21'S	143°33'W	82.9	100	17	85.8	78.5	1009	01	0,4,8	2	7	3	100	3	35.48	0.48
218	0000	2/18	02°56'S	143°46'W	82.8	110	15	83.6	77.3	1007	03	4,5,8	6	7	3	080	3	-	-
219	0300	2/18	02°27'S	144°00'W	82.7	100	15	84.6	78.4	1007	01	8	1	7	3	070	3	35.52	0.40
220	0600	2/18	02°07'S	144°08'W	82.3	110	15	83.0	78.1	1008	01	X	1	6	3	080	3	-	-
221	0900	2/18	01°41'S	144°23'W	82.0	110	14	83.2	78.4	1009	00	X	X	6	3	080	3	35.43	0.25
222	1200	2/18	01°15'S	144°38'W	82.3	100	13	82.2	77.7	1008	00	X	X	6	3	080	3	-	-
223	1500	2/18	00°50'S	144°52'W	82.2	120	14	82.0	77.5	1008	03	0,8	2	6	3	080	3	35.44	0.30
224	1800	2/18	00°23'S	145°06'W	81.7	120	12	83.0	78.4	1010	03	6	6	6	3	100	3	-	-
225	2100	2/18	00°04'N	145°20'W	82.3	070	18	82.7	79.2	1010	16	0,8,9	3	7	3	090	3	35.37	0.50
226	0000	2/19	00°31'N	145°33'W	82.0	100	15	83.3	79.4	1008	15	5,4,8	7	6	3	110	3	-	-
227	0300	2/19	00°57'N	145°46'W	82.2	080	18	83.7	78.5	1008	01	4,5,8	6	7	3	080	3	35.35	0.28
228	0600	2/19	01°22'N	145°59'W	82.5	090	21	83.0	78.2	1009	01	X	2	6	4	090	3	-	-
229	1200	2/19	02°07'N	146°16'W	82.5	100	18	82.5	77.7	1008	01	X	2	6	4	090	3	-	-
230	1500	2/19	02°33'N	146°28'W	82.7	120	14	83.6	78.0	1009	00	X	X	6	3	120	3	35.43	0.71
231	1800	2/19	02°58'N	146°40'W	82.9	110	17	84.8	79.0	1010	03	0,4,6,8	3	7	4	110	3	-	-
232	2100	2/19	03°26'N	146°51'W	82.8	100	19	86.3	79.6	1010	15	8,4,9	2	7	4	080	3	35.10	0.28
233	0000	2/20	03°50'N	147°02'W	83.8	100	14	86.2	79.8	1008	02	4,8	2	7	4	100	3	-	-
234	0300	2/20	04°15'N	147°12'W	83.2	090	17	80.0	78.0	1008	63	X	9	5	4	100	3	34.88	0.21
235	0600	2/20	04°40'N	147°23'W	82.7	100	09	80.6	76.8	1010	80	X	X	5	4	100	3	-	-
236	0900	2/20	04°59'N	147°28'W	82.8	060	19	82.5	79.0	1010	01	X	X	6	4	070	3	-	-
237	1200	2/20	05°24'N	147°38'W	82.8	070	19	82.5	78.5	1009	01	X	2	6	4	080	3	-	-
238	1500	2/20	05°50'N	147°49'W	82.6	070	16	82.4	77.9	1010	00	X	X	6	4	070	3	-	-
239	1800	2/20	06°15'N	147°59'W	82.7	070	16	83.6	78.4	1011	03	2,8,9	3	7	4	070	3	-	-
240	2100	2/20	06°40'N	148°08'W	82.6	080	17	85.2	78.3	1012	02	8	3	7	4	070	3	-	-
241	0000	2/21	07°04'N	148°18'W	83.2	070	18	82.5	77.8	1010	03	8	7	7	4	070	3	-	-
242	0300	2/21	07°27'N	148°27'W	83.2	080	14	83.6	78.5	1010	01	4,6,9	3	7	4	070	3	-	-
243	0600	2/21	07°49'N	148°37'W	82.1	080	20	82.8	76.5	1012	00	X	X	6	4	080	3	-	-
244	0900	2/21	08°10'N	148°50'W	81.8	080	18	81.8	76.4	1012	01	8	2	6	4	080	3	-	-
245	1200	2/21	08°35'N	149°08'W	81.6	090	16	81.5	75.6	1012	01	X	2	6	4	080	3	-	-

Table 3.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 43 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
246	1500	2/21	09°02'N	149°28'W	81.0	100	15	81.0	75.8	1012	00	X	X	6	3	080	3	-	-
247	1800	2/21	09°26'N	149°42'W	81.3	090	15	82.6	75.6	1014	02	4,8	2	7	3	070	3	-	-
248	2100	2/21	09°52'N	149°56'W	81.0	090	17	83.7	76.1	1015	02	8	2	7	3	080	3	-	-
249	0000	2/22	10°16'N	150°10'W	81.8	090	14	84.0	76.5	1012	01	8	1	7	3	080	3	-	-
250	0300	2/22	10°41'N	150°26'W	81.6	100	13	84.0	76.9	1012	02	8	2	8	3	080	3	-	-
251	0600	2/22	11°06'N	150°42'W	80.0	100	17	82.2	76.2	1014	00	X	X	7	3	080	3	-	-
252	1200	2/22	11°55'N	151°01'W	78.3	060	12	79.0	74.7	1015	00	X	X	7	3	060	3	-	-
253	1800	2/22	12°49'N	151°26'W	78.0	100	11	80.4	74.7	1016	01	8,1	2	7	2	070	1	-	-
254	0000	2/23	13°42'N	151°57'W	79.0	080	07	80.2	74.2	1014	02	8	2	7	2	080	1	-	-
255	0600	2/23	14°29'N	152°31'W	79.4	080	05	80.8	74.7	1015	02	X	2	6	2	090	1	-	-
256	1200	2/23	15°11'N	153°01'W	78.4	020	04	78.8	73.5	1015	00	X	X	6	2	XXX	9	-	-
257	1800	2/23	15°58'N	153°36'W	77.9	230	06	77.2	73.3	1017	01	8,4	2	7	1	290	1	-	-
258	0000	2/24	16°43'N	154°12'W	77.5	240	12	78.0	72.5	1016	01	1,8	3	7	2	290	1	-	-
259	0600	2/24	17°25'N	154°52'W	77.1	260	11	77.0	72.0	1016	02	X	1	6	2	270	1	-	-
260	1200	2/24	18°02'N	155°25'W	76.0	310	11	76.0	70.5	1015	00	X	X	6	2	XXX	9	-	-
261	1800	2/24	18°46'N	155°58'W	76.2	340	10	75.2	71.3	1017	02	4,8	6	8	2	300	3	-	-
262	0000	2/25	19°24'N	156°29'W	77.0	020	14	76.0	71.0	1016	01	4,6	4	8	3	020	3	-	-
263	0600	2/25	20°03'N	157°06'W	76.3	050	19	74.0	69.4	1018	02	X	3	6	4	040	3	-	-

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
1	0725	2/8	21°36'N	157°46'W	74.5	090	09	73.1	70.2	1016	00	X	X	8	2	XXX	1	34.97	-
2	1005	2/8	21°59'N	157°47'W	75.1	340	07	74.9	71.0	1016	00	X	X	8	2	XXX	1	35.08	-
3	1245	2/8	22°20'N	157°45'W	74.0	300	08	74.5	71.2	1015	01	4	5	8	2	050	1	34.94	-
4	1400	2/8	22°20'N	157°55'W	74.0	250	07	73.8	69.3	1015	02	4,8	5	8	2	XXX	1	35.01	-
5	1600	2/8	22°03'N	157°56'W	73.7	190	07	74.1	69.1	1015	02	4,8	3	8	2	XXX	1	34.95	-
6	1825	2/8	21°49'N	157°56'W	73.3	160	09	73.0	68.3	1015	03	4,6,8	6	8	2	320	1	35.01	-
7	2200	2/8	21°39'N	158°24'W	75.1	270	05	75.8	70.2	1016	02	4,6,8	6	8	1	XXX	1	35.08	-
8	0000	2/9	21°39'N	158°42'W	74.8	280	09	76.1	70.3	1015	02	4,6,8	4	8	1	170	1	35.06	-
9	0230	2/9	21°38'N	159°00'W	76.3	170	08	75.0	70.5	1014	01	8	2	8	1	180	1	35.09	-
10	0405	2/9	21°25'N	158°59'W	75.9	140	08	75.0	70.4	1015	01	8	1	8	1	180	1	35.05	-
11	0625	2/9	21°24'N	158°40'W	75.2	150	09	74.3	72.1	1015	02	X	X	8	1	XXX	1	35.03	-
12	0855	2/9	21°25'N	158°17'W	74.4	140	05	74.5	70.2	1015	02	X	X	8	1	XXX	1	34.98	-
13	1800	2/9	20°40'N	157°33'W	75.5	140	08	75.7	71.5	1016	02	8	1	8	1	130	1	34.95	0.27
14	0000	2/10	19°55'N	157°17'W	76.5	120	02	78.3	72.2	1014	02	8	1	8	1	130	1	34.11	0.22
15	0600	2/10	19°10'N	156°48'W	75.2	130	03	75.5	72.5	1017	02	X	X	8	2	130	1	35.04	0.27
16	1200	2/10	18°30'N	156°23'W	75.2	090	08	76.0	72.9	1016	02	8	1	8	2	140	1	34.95	0.23
17	1800	2/10	17°50'N	156°01'W	75.6	100	09	76.1	73.2	1017	02	8	1	8	2	110	1	34.82	0.29
18	0000	2/11	17°10'N	155°40'W	76.2	080	14	76.9	73.2	1014	03	8	6	8	2	100	1	34.79	0.43
19	0600	2/11	16°28'N	155°20'W	75.9	070	16	76.2	72.2	1016	00	X	X	8	3	100	3	34.70	0.35
20	1200	2/11	15°50'N	155°02'W	75.7	080	17	76.6	72.2	1015	00	X	X	8	4	100	3	34.85	0.26
21	1800	2/11	15°13'N	154°44'W	75.9	080	19	78.4	72.5	1015	01	8	2	8	4	120	3	34.63	0.27
22	0000	2/12	14°34'N	154°25'W	77.4	080	19	77.3	73.0	1012	03	8	5	8	5	090	3	34.79	0.26
23	0600	2/12	13°50'N	154°05'W	77.2	080	21	77.2	71.1	1014	02	X	X	8	5	090	3	34.36	0.39
24	1200	2/12	13°10'N	153°46'W	77.5	060	17	77.7	71.6	1012	00	X	X	8	5	090	3	34.42	0.28
25	1800	2/12	12°28'N	153°26'W	77.5	080	18	77.9	72.9	1014	03	6,4	7	8	5	090	3	34.41	0.32
26	0000	2/13	11°51'N	153°09'W	78.4	070	21	77.7	72.7	1010	01	8	2	8	5	100	3	34.49	0.36
27	0600	2/13	11°11'N	152°54'W	78.3	070	16	78.1	74.0	1012	02	X	1	8	5	100	4	34.46	0.44
28	1200	2/13	10°29'N	152°34'W	78.9	080	17	79.3	75.5	1010	02	X	X	8	5	100	4	34.66	0.35
29	1800	2/13	09°47'N	152°14'W	78.9	050	14	79.5	76.3	1013	14	7,5	8	7	4	100	4	34.52	0.36
30	0000	2/14	09°01'N	151°53'W	80.0	070	18	80.5	77.8	1010	21	7,5	8	7	4	100	4	34.72	0.23
31	0600	2/14	08°16'N	151°32'W	81.1	090	10	79.8	77.5	1011	00	X	X	7	4	100	4	34.68	0.53
32	1200	2/14	07°39'N	151°01'W	81.4	080	13	80.8	78.2	1009	00	X	X	7	4	100	4	34.60	0.35
33	1800	2/14	06°59'N	150°28'W	81.9	120	22	77.5	76.9	1011	62	7	8	7	4	100	4	34.56	0.67
34	0000	2/15	06°18'N	150°04'W	82.9	100	10	82.0	78.2	1008	01	4,8	6	8	3	090	3	34.64	0.69
35	0600	2/15	05°31'N	150°06'W	82.8	100	07	82.0	78.6	1008	00	X	X	8	3	090	3	34.94	0.42

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
36	1200	2/15	05°02'N	150°03'W	82.4	090	08	81.0	79.0	1008	00	X	X	8	3	090	3	35.11	0.61
37	1700	2/15	04°42'N	150°10'W	82.3	090	12	82.8	78.5	1009	03	8,4	5	8	3	090	1	-	-
38	2205	2/15	04°44'N	150°05'W	83.2	090	11	85.5	80.1	1008	01	8	2	8	3	090	1	35.09	0.55
39	0225	2/16	04°40'N	149°57'W	83.3	090	07	84.0	78.5	1006	02	8	1	9	3	090	1	-	-
40	0900	2/16	04°17'N	149°56'W	82.5	100	11	81.9	78.2	1008	02	X	X	9	3	090	1	35.22	0.54
41	1655	2/16	03°55'N	150°01'W	82.6	110	10	82.2	78.2	1007	02	8	3	9	2	090	1	-	-
42	2205	2/16	03°52'N	150°00'W	83.1	110	10	83.1	79.4	1007	03	8	6	9	2	120	1	35.12	0.60
43	0050	2/17	03°50'N	149°52'W	82.8	110	10	80.8	77.5	1005	21	8	7	7	3	120	1	-	-
44	0900	2/17	03°18'N	150°00'W	82.6	130	14	81.0	78.5	1008	02	X	X	9	3	120	1	35.07	0.46
45	1650	2/17	02°57'N	150°12'W	82.3	160	16	81.8	77.3	1008	02	8,6	3	9	3	160	1	-	-
46	2205	2/17	02°57'N	150°17'W	82.7	130	11	83.3	78.3	1008	02	8	1	9	3	120	1	35.10	0.56
47	0040	2/18	02°53'N	150°14'W	83.2	120	12	82.0	77.5	1006	02	8	1	9	3	120	1	-	-
48	0900	2/18	02°19'N	150°07'W	82.6	110	11	82.4	78.0	1009	00	X	X	9	3	120	1	35.03	0.31
49	1647	2/18	01°55'N	150°14'W	82.5	110	10	82.9	78.8	1010	02	8	2	8	2	110	1	-	-
50	2206	2/18	01°54'N	150°20'W	83.0	110	11	84.0	78.8	1009	02	8	2	8	2	110	1	35.09	0.44
51	0050	2/19	01°51'N	150°18'W	83.6	130	06	83.5	78.9	1009	02	8	2	8	2	110	1	-	-
52	0900	2/19	01°19'N	150°14'W	82.8	110	18	78.8	77.2	1010	63	X	X	6	3	110	1	35.11	0.54
53	1637	2/19	00°54'N	150°19'W	82.4	110	19	82.3	78.3	1009	01	1,8	6	8	4	110	4	-	-
54	2203	2/19	00°53'N	150°19'W	82.6	110	13	84.0	78.9	1010	60	8,7	6	7	4	110	4	35.17	0.55
55	0045	2/20	00°52'N	150°17'W	83.0	110	12	81.9	71.3	1008	01	8,7	5	7	3	110	4	-	-
56	0900	2/20	00°27'N	150°06'W	82.2	100	10	82.4	78.8	1010	52	X	X	7	3	110	3	35.23	0.51
57	1639	2/20	00°06'N	150°06'W	82.1	120	12	82.1	79.3	1010	20	8,7	6	7	2	120	4	-	-
58	2200	2/20	00°11'N	150°02'W	82.3	120	13	83.7	79.1	1010	01	8	3	8	2	120	1	35.34	0.69
59	0027	2/21	00°07'N	150°00'W	82.7	120	13	83.2	78.8	1008	02	8	2	8	2	120	1	-	-
60	0900	2/21	00°21'S	150°04'W	82.2	100	14	81.7	78.8	1012	02	X	X	8	3	110	1	35.54	0.58
61	1635	2/21	00°48'S	150°10'W	82.2	110	13	81.1	78.2	1012	25	9	6	8	3	100	1	-	-
62	2200	2/21	00°45'S	150°12'W	82.7	090	16	84.2	79.1	1012	01	8	2	8	3	090	1	35.47	0.37
63	0015	2/22	00°44'S	150°08'W	82.5	090	15	81.0	79.0	1010	02	8	3	8	3	090	1	-	-
64	0600	2/22	01°08'S	149°46'W	82.2	060	15	81.8	78.8	1011	00	X	X	8	3	090	1	35.42	0.45
65	0900	2/22	01°23'S	149°33'W	82.2	060	15	81.7	78.1	1012	00	X	X	8	3	090	1	-	-
66	1200	2/22	01°38'S	149°19'W	82.1	050	16	81.2	78.0	1010	02	X	X	8	3	090	1	35.48	0.36
67	1500	2/22	01°52'S	149°04'W	82.0	050	16	81.4	78.0	1012	02	X	X	8	3	090	1	-	-
68	1800	2/22	02°10'S	148°50'W	82.2	070	16	82.5	78.0	1014	01	8	2	8	3	090	1	35.60	0.35
69	2100	2/22	02°25'S	148°37'W	82.4	060	16	81.9	77.9	1013	02	8	1	8	3	090	1	-	-
70	0000	2/23	02°39'S	148°20'W	82.8	060	14	81.9	77.6	1010	02	6,8	2	8	3	090	1	35.44	0.44

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
71	0300	2/23	02°52'S	148°00'W	82.8	060	16	81.9	77.8	1010	03	4,8	3	8	3	090	1	-	-
72	0600	2/23	03°05'S	147°40'W	82.6	060	10	81.8	77.9	1012	00	X	X	8	2	090	1	35.56	0.35
73	0900	2/23	03°15'S	147°23'W	82.6	050	10	81.2	78.3	1013	00	X	X	8	2	090	1	-	-
74	1200	2/23	03°28'S	147°02'W	82.5	050	13	79.2	75.9	1011	00	X	X	8	2	090	1	35.51	0.41
75	1500	2/23	03°39'S	146°42'W	82.5	050	09	81.7	77.2	1012	00	X	X	8	2	090	1	-	-
76	1800	2/23	03°52'S	146°22'W	82.5	050	12	82.0	78.2	1014	03	6,8	6	8	2	090	1	35.65	0.36
77	2100	2/23	04°09'S	146°02'W	82.8	040	08	82.1	78.3	1013	02	6,8	6	8	2	080	1	-	-
78	0000	2/24	04°26'S	145°42'W	83.5	040	06	83.0	78.5	1010	15	6,8,9	6	8	2	080	1	35.46	0.80
79	0300	2/24	04°42'S	145°22'W	83.6	040	08	82.4	78.2	1010	01	8	3	8	2	080	1	-	-
80	0600	2/24	04°59'S	145°02'W	83.6	040	09	82.4	78.0	1012	00	X	X	8	2	080	1	35.63	0.34
81	0900	2/24	05°16'S	144°41'W	83.4	030	10	82.0	78.3	1012	01	8	1	8	2	080	1	-	-
82	1200	2/24	05°35'S	144°20'W	83.2	030	13	81.5	78.3	1010	00	X	X	8	2	080	1	35.59	0.31
83	1500	2/24	05°52'S	143°58'W	83.2	030	10	82.0	78.4	1010	01	8	2	8	2	080	1	-	-
84	1800	2/24	06°07'S	143°37'W	83.3	040	11	82.7	78.5	1012	02	8	2	8	2	080	1	35.66	0.29
85	2100	2/24	06°22'S	143°16'W	84.0	030	12	82.8	78.8	1011	03	8	3	8	2	060	1	-	-
86	0000	2/25	06°40'S	142°53'W	84.4	040	12	82.4	78.4	1009	03	8	4	8	2	060	1	35.81	0.51
87	0300	2/25	06°57'S	142°31'W	84.1	040	13	82.5	77.5	1010	01	8	2	8	2	060	1	-	-
88	0600	2/25	07°12'S	142°10'W	84.0	040	11	82.6	77.9	1012	00	X	X	8	2	060	1	35.80	-
89	0900	2/25	07°28'S	141°50'W	84.1	030	11	81.5	77.8	1012	02	X	X	8	2	060	1	-	-
90	1200	2/25	07°43'S	141°29'W	84.1	030	07	82.2	77.1	1011	00	X	X	8	2	060	1	35.91	0.38
91	1500	2/25	07°58'S	141°09'W	84.1	030	06	82.1	76.3	1011	00	8	2	8	1	060	1	-	-
92	1800	2/25	08°14'S	140°48'W	83.9	040	06	83.9	76.4	1012	01	6,8	2	8	1	060	1	35.88	0.35
93	2100	2/25	08°34'S	140°32'W	85.0	050	06	86.1	77.3	1012	02	6	1	8	1	060	1	-	-
94	0000	2/26	08°52'S	140°18'W	84.7	050	06	83.5	77.3	1010	02	4,8	2	8	1	060	1	35.88	0.36
95	1925	2/27	08°47'S	140°20'W	85.5	360	07	85.9	78.8	1010	01	8	2	8	2	230	1	-	-
96	2200	2/27	08°34'S	140°36'W	86.0	030	07	86.3	78.5	1009	02	8	3	8	2	320	1	35.91	0.35
97	2155	2/28	07°42'S	140°11'W	84.7	320	06	85.6	79.5	1008	01	8	2	8	2	030	1	35.90	0.35
98	0107	3/1	07°57'S	139°47'W	85.0	340	09	84.7	78.3	1007	02	4,8	7	8	2	030	1	-	-
99	2200	3/1	08°41'S	139°18'W	85.1	350	07	86.1	78.3	1008	03	8	6	8	2	030	1	35.93	0.35
100	2037	3/2	09°22'S	139°01'W	84.1	050	10	83.6	77.1	1010	03	4,8	5	8	3	030	1	-	-
101	2037	3/3	10°01'S	138°52'W	84.5	060	16	83.3	78.1	1011	03	8	4	8	2	060	1	-	-
102	2150	3/3	10°05'S	138°51'W	84.5	060	16	84.5	78.7	1010	02	8	4	8	2	060	1	35.76	0.43
103	2200	3/5	09°36'S	139°48'W	84.5	040	07	86.2	78.2	1010	01	8	1	8	2	030	1	35.83	0.43
104	1700	3/6	09°35'S	139°51'W	84.0	080	17	83.8	77.0	1011	03	8	2	8	3	080	1	-	-
105	1900	3/6	09°35'S	139°50'W	83.8	090	17	84.6	77.2	1012	01	8	2	8	3	090	1	-	-

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
106	2100	3/6	09°36'S	139°52'W	84.1	060	14	85.5	78.3	1010	03	8	3	8	3	080	1	-	-
107	2300	3/6	09°34'S	139°51'W	84.3	070	14	84.8	77.3	1008	02	8	2	8	3	080	1	35.97	-
108	0100	3/7	09°34'S	139°51'W	84.4	070	14	85.5	76.8	1008	02	8	1	8	3	080	1	-	-
109	0300	3/7	09°35'S	139°50'W	84.2	070	14	84.4	77.9	1008	02	8	2	8	3	080	1	-	-
110	0500	3/7	09°34'S	139°51'W	84.0	070	19	83.0	77.7	1008	02	8	3	8	3	080	1	-	-
111	0700	3/7	09°34'S	139°51'W	84.0	070	14	83.7	76.2	1009	02	8	1	8	3	080	1	-	-
112	0900	3/7	09°34'S	139°51'W	84.0	070	14	83.4	76.2	1009	02	8	1	8	3	080	1	-	-
113	1100	3/7	09°34'S	139°51'W	83.9	110	08	83.6	76.5	1008	02	8	1	8	3	080	1	-	-
114	1300	3/7	09°34'S	139°51'W	84.2	090	07	83.1	75.7	1008	02	8	1	8	2	080	1	-	-
115	1500	3/7	09°34'S	139°49'W	83.5	070	10	80.0	76.3	1008	25	4,9	6	7	2	080	1	-	-
116	1800	3/10	10°10'S	141°36'W	84.3	100	19	85.2	78.6	1011	03	8	3	8	3	100	1	-	-
117	0000	3/11	10°42'S	142°16'W	84.8	100	14	84.8	77.7	1008	02	8	3	8	3	100	1	-	-
118	0600	3/11	11°14'S	142°48'W	84.0	090	14	84.0	77.5	1010	00	X	X	8	3	100	1	-	-
119	1200	3/11	11°46'S	143°24'W	84.5	060	12	82.0	77.7	1010	00	X	X	8	2	100	1	-	-
120	1800	3/11	12°19'S	144°00'W	84.4	130	10	82.0	78.8	1012	03	6,8	7	8	2	130	1	-	-
121	0000	3/12	12°52'S	144°31'W	84.6	100	07	83.7	76.9	1009	02	6,8	5	8	2	130	1	-	-
122	0600	3/12	13°28'S	145°11'W	84.8	100	10	83.3	78.6	1010	00	X	X	8	2	130	1	-	-
123	1200	3/12	14°07'S	145°47'W	84.5	100	14	82.8	77.6	1010	03	8	4	8	2	100	1	-	-
124	1800	3/12	14°36'S	146°22'W	84.5	100	10	84.3	78.8	1012	01	8,6	2	8	2	110	1	-	-
125	2028	3/12	14°44'S	146°39'W	84.8	100	09	84.2	78.4	1011	02	8	3	8	2	110	1	-	-
126	0000	3/12	14°52'S	147°12'W	85.0	130	07	84.7	77.9	1008	03	5,8	6	8	2	110	1	-	-
127	1900	3/13	14°48'S	147°54'W	84.6	080	11	85.6	79.5	1010	02	8	4	8	2	110	1	-	-
128	2200	3/13	14°57'S	147°56'W	85.0	080	14	87.4	80.0	1009	80	8,9	5	8	2	110	1	-	-
129	0000	3/15	15°38'S	148°18'W	85.0	080	14	83.9	79.6	1010	25	8,9,4	5	8	2	080	1	-	-
130	0600	3/15	16°20'S	148°44'W	84.0	100	13	84.1	79.2	1012	00	X	X	8	2	080	1	-	-
131	1200	3/15	17°04'S	149°12'W	84.0	080	17	83.5	79.3	1012	00	X	X	8	3	080	1	-	-
132	0000	3/20	17°12'S	149°14'W	84.1	120	12	84.9	77.8	1012	03	8	2	8	3	090	1	-	-
133	0600	3/20	16°41'S	148°42'W	83.9	120	15	84.5	77.9	1013	00	X	X	8	2	090	1	-	-
134	1200	3/20	16°13'S	148°08'W	84.1	100	14	83.8	77.0	1012	00	X	X	8	2	090	1	-	-
135	1800	3/20	15°44'S	147°35'W	84.0	110	12	86.5	78.3	1014	03	8	2	8	3	090	1	-	-
136	0000	3/21	15°16'S	147°01'W	84.7	090	18	84.4	77.3	1010	02	8	2	8	3	090	1	-	-
137	0600	3/21	14°48'S	146°23'W	84.5	090	14	84.6	78.6	1012	00	X	X	8	3	090	1	-	-
138	1200	3/21	14°13'S	145°51'W	84.4	100	15	83.6	77.8	1011	00	X	X	8	3	090	1	-	-
139	1800	3/21	13°42'S	145°20'W	84.3	100	14	83.9	78.0	1014	03	6,8	4	8	3	090	1	-	-
140	0000	3/22	13°09'S	144°48'W	85.0	100	12	84.0	78.5	1011	02	6,8	4	8	3	090	1	-	-

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO$_4$-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
141	0600	3/22	12°34'S	144°16'W	84.4	120	14	85.3	79.1	1013	00	X	X	8	3	090	1	-	-
142	1200	3/22	12°00'S	143°47'W	84.4	100	20	83.5	77.2	1011	00	X	X	8	3	090	1	-	-
143	1800	3/22	11°28'S	143°16'W	84.1	090	15	84.9	78.9	1012	03	8,5	3	8	3	090	4	-	-
144	0000	3/23	10°59'S	142°40'W	85.0	090	16	85.3	78.8	1010	02	8	3	8	3	090	4	-	-
145	0600	3/23	10°32'S	142°09'W	84.4	120	14	85.7	77.8	1012	00	X	X	8	3	090	4	-	-
146	1200	3/23	10°05'S	141°36'W	84.2	110	20	84.8	77.5	1010	00	X	X	8	3	090	4	-	-
147	1800	3/23	09°40'S	141°04'W	84.4	110	17	85.5	78.2	1011	03	8	2	8	3	090	4	-	-
148	0000	3/24	09°18'S	140°36'W	84.9	100	18	84.8	78.2	1008	02	8	2	8	4	090	4	-	-
149	1600	3/26	09°08'S	139°36'W	83.8	110	09	83.0	77.9	1011	03	8	2	8	3	110	1	35.87	0.35
150	1900	3/26	09°11'S	139°20'W	84.0	120	14	85.7	79.8	1012	02	8	3	8	3	100	1	35.90	0.35
151	2200	3/26	09°10'S	138°58'W	84.0	100	09	84.5	77.4	1010	02	6	5	8	3	100	1	35.82	0.34
152	0100	3/27	09°12'S	138°42'W	83.9	140	19	84.1	78.0	1008	15	4	7	7	4	100	4	35.81	0.32
153	0400	3/27	09°12'S	138°24'W	83.7	180	08	83.0	77.1	1010	00	X	X	7	3	100	4	35.76	0.41
154	0700	3/27	09°11'S	138°06'W	83.8	080	09	84.2	76.0	1012	00	X	X	7	3	100	4	35.78	0.50
155	1000	3/27	09°10'S	137°50'W	83.8	080	10	83.8	77.5	1010	00	X	X	7	3	100	4	35.67	0.43
156	1300	3/27	09°09'S	137°34'W	83.8	090	10	82.7	75.6	1010	00	X	X	8	3	100	4	35.78	0.44
157	1600	3/27	09°07'S	137°14'W	83.8	080	09	84.3	77.5	1011	02	8	6	8	3	090	4	35.75	0.69
158	1900	3/27	09°10'S	136°56'W	83.8	110	08	86.3	78.1	1012	01	8	3	8	3	090	4	35.76	0.44
159	2200	3/27	09°12'S	136°36'W	84.1	090	08	85.8	78.9	1010	03	4,8	5	8	3	090	4	35.79	0.44
160	0100	3/28	09°12'S	136°15'W	84.1	080	09	84.9	77.9	1009	02	6,8	4	8	3	090	4	35.85	0.45
161	0400	3/28	09°12'S	136°00'W	83.9	080	10	83.5	77.9	1010	00	X	X	7	3	090	4	-	0.44
162	0600	3/28	09°11'S	136°15'W	83.8	080	11	80.8	76.8	1012	50	X	X	7	3	090	4	35.84	0.42
163	0900	3/28	09°08'S	136°36'W	83.5	080	09	82.4	77.3	1011	80	X	X	7	3	090	4	35.75	0.44
164	1200	3/28	09°07'S	136°56'W	83.7	070	12	82.8	77.7	1010	00	X	X	7	3	090	4	35.77	0.46
165	1500	3/28	09°05'S	137°16'W	83.7	080	12	84.0	78.1	1011	03	8	2	7	3	090	4	35.79	0.74
166	1833	3/28	09°00'S	137°29'W	84.0	050	14	85.7	80.5	1012	02	8	2	8	3	090	4	35.82	0.50
167	2100	3/28	09°00'S	137°48'W	84.2	080	13	86.5	79.6	1011	02	8	3	8	3	090	4	35.74	0.39
168	0000	3/29	09°04'S	138°10'W	84.4	100	14	85.1	79.9	1009	02	8	2	8	3	090	4	35.73	0.50
169	0300	3/29	09°09'S	138°33'W	84.0	090	15	84.6	77.9	1009	02	8	2	8	3	090	4	35.73	0.45
170	0600	3/29	09°09'S	138°53'W	84.0	100	14	84.0	77.5	1011	00	X	X	7	3	090	4	35.75	0.41
171	0900	3/29	09°08'S	139°10'W	84.1	090	16	84.5	78.2	1010	02	8	1	7	3	090	4	35.86	0.36
172	1200	3/29	09°08'S	139°27'W	84.2	090	14	85.0	78.9	1010	00	X	X	7	3	090	4	35.88	0.42
173	1500	3/29	09°06'S	139°45'W	84.1	080	11	83.9	77.5	1010	01	8	1	8	3	090	4	35.83	0.34
174	1836	3/29	08°42'S	139°42'W	84.2	090	12	85.7	80.2	1010	02	8	1	8	3	080	1	35.90	0.39
175	2100	3/29	08°28'S	139°41'W	84.2	100	13	85.5	79.4	1009	02	8,1	2	8	3	080	1	35.81	0.44

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
176	0117	3/30	08°04'S	139°46'W	84.6	090	12	85.1	80.1	1008	03	8	4	8	3	080	1	35.78	0.35
177	0300	3/30	07°51'S	139°47'W	84.5	090	12	84.1	79.0	1008	02	8	3	8	2	080	1	35.76	0.44
178	0600	3/30	07°32'S	139°46'W	85.2	100	09	84.1	79.2	1010	00	X	X	8	2	080	1	35.72	0.61
179	0900	3/30	07°14'S	139°45'W	84.0	090	09	85.0	79.9	1010	00	X	X	7	2	080	1	35.79	0.59
180	1200	3/30	06°57'S	139°44'W	83.9	100	10	83.5	78.9	1009	00	X	X	7	2	080	1	35.60	0.52
181	1500	3/30	06°40'S	139°42'W	83.6	100	12	82.8	78.4	1010	03	8	3	7	2	080	1	35.57	0.52
182	1800	3/30	06°23'S	139°40'W	83.3	090	14	83.3	79.2	1011	02	8	4	8	3	080	1	35.56	0.54
183	2100	3/30	05°59'S	139°40'W	83.5	100	10	84.2	79.3	1010	02	8	4	8	3	080	1	35.10	0.59
184	0000	3/31	05°41'S	139°38'W	83.5	080	13	84.4	79.0	1008	01	8	5	7	3	080	1	35.46	0.52
185	0300	3/31	05°27'S	139°39'W	83.5	090	12	83.8	78.7	1010	15	9,4	6	7	3	080	1	35.46	0.51
186	0600	3/31	05°44'S	139°40'W	83.2	110	12	83.0	78.6	1011	00	X	X	7	3	080	1	35.41	0.54
187	0900	3/31	06°02'S	139°39'W	83.2	110	12	82.3	78.7	1012	00	X	X	8	3	080	1	35.45	0.53
188	1200	3/31	06°20'S	139°39'W	83.2	090	11	82.8	78.6	1010	00	X	X	7	3	080	1	35.54	0.53
189	1500	3/31	06°36'S	139°39'W	83.4	080	10	82.4	78.1	1011	02	8,1	4	8	3	080	1	35.56	0.52
190	1800	3/31	06°57'S	139°39'W	83.6	080	13	84.1	79.0	1013	03	4,8	5	8	3	080	1	35.69	0.51
191	2100	3/31	07°18'S	139°39'W	84.1	080	09	83.9	79.0	1012	02	4,8	3	8	3	080	1	35.71	0.60
192	0000	4/1	07°39'S	139°38'W	84.4	040	13	83.9	78.9	1010	03	8,4	5	8	3	080	1	35.75	0.61
193	0300	4/1	07°56'S	139°38'W	84.5	070	12	83.4	78.3	1010	02	8	6	8	3	080	1	35.72	0.35
194	0600	4/1	08°10'S	139°44'W	84.3	070	09	83.8	79.1	1012	00	X	X	7	2	080	1	35.68	0.37
195	0900	4/1	08°24'S	139°51'W	84.2	070	08	84.0	77.9	1012	00	X	X	7	2	080	1	35.72	0.34
196	1200	4/1	08°38'S	139°57'W	84.3	060	09	83.5	78.1	1010	02	8	1	8	2	080	1	35.70	0.35
197	1500	4/3	09°08'S	139°40'W	84.0	070	13	82.8	77.3	1010	00	8	2	8	3	080	4	35.83	0.41
198	1800	4/3	09°08'S	140°02'W	84.2	080	14	83.1	77.8	1012	02	8	1	8	3	080	1	35.83	0.29
199	2100	4/3	09°09'S	140°26'W	84.7	100	09	85.2	77.4	1011	01	8	1	8	3	080	1	35.87	0.52
200	0031	4/4	09°11'S	140°42'W	85.1	070	11	87.2	78.0	1008	02	8	1	8	3	080	1	35.87	0.32
201	0300	4/4	09°10'S	140°54'W	85.4	350	05	86.1	78.2	1009	02	8	2	8	3	080	1	35.88	0.33
202	0600	4/4	09°08'S	141°14'W	84.6	140	06	84.1	78.0	1011	02	8	2	7	2	080	1	35.88	0.32
203	0900	4/4	09°08'S	141°34'W	84.6	040	08	83.2	77.6	1012	03	8	6	8	2	080	1	35.85	0.32
204	1200	4/4	09°07'S	141°52'W	84.8	340	06	83.5	75.4	1010	01	8	1	7	2	080	1	35.86	0.33
205	1500	4/4	09°07'S	142°09'W	84.6	050	06	82.5	75.5	1010	02	8	1	8	2	080	1	35.86	0.36
206	1800	4/4	09°07'S	142°32'W	84.7	040	06	83.3	75.7	1012	02	8	1	8	2	080	1	35.85	0.32
207	2100	4/4	09°08'S	142°54'W	85.9	020	06	83.2	77.0	1012	03	4,8	3	8	2	080	1	35.91	0.40
208	0000	4/5	09°08'S	143°12'W	87.7	350	03	85.4	77.0	1010	03	8,1	5	8	1	080	1	35.93	0.32
209	0300	4/5	09°07'S	143°16'W	87.5	160	03	85.2	76.4	1008	02	4,8	5	8	1	080	1	35.85	0.38
210	0600	4/5	09°05'S	142°58'W	86.0	090	04	84.1	76.9	1010	01	X	2	8	1	080	1	35.87	0.33

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
211	0900	4/5	09°03'S	142°44'W	85.0	090	05	83.8	75.0	1010	02	4	2	7	2	080	1	35.84	0.44
212	1200	4/5	09°04'S	142°28'W	84.9	080	07	82.3	75.2	1009	03	8	4	7	2	080	1	35.84	0.34
213	1500	4/5	09°05'S	142°10'W	84.4	060	04	82.9	75.0	1010	02	8	3	8	2	080	1	35.88	0.35
214	1800	4/5	09°05'S	141°50'W	84.7	070	08	84.4	76.3	1011	02	8	3	8	2	080	1	35.85	0.34
215	2100	4/5	09°08'S	141°29'W	85.3	040	06	84.3	76.9	1010	01	8	2	8	2	080	1	35.88	0.27
216	0000	4/6	09°09'S	141°08'W	86.0	060	06	85.5	77.3	1007	02	8	2	8	2	060	1	35.87	0.80
217	0300	4/6	09°08'S	140°46'W	86.1	040	03	83.7	75.5	1007	02	8	2	8	1	060	1	35.89	0.28
218	0600	4/6	09°09'S	140°28'W	85.6	150	05	83.5	75.1	1009	02	8	2	7	0	060	1	35.90	0.35
219	0900	4/6	09°10'S	140°13'W	84.8	050	06	82.0	76.1	1010	02	8	2	8	1	060	1	35.84	0.35
220	1200	4/6	09°12'S	139°57'W	84.5	020	11	82.4	75.9	1008	02	8	2	7	2	060	1	35.86	0.38
221	1500	4/6	09°16'S	139°40'W	84.4	030	12	82.5	75.9	1008	02	8	1	7	2	060	1	35.93	0.35
222	1800	4/6	09°36'S	139°40'W	84.5	030	15	86.2	77.9	1010	02	8	1	8	3	060	1	35.91	0.36
223	2100	4/6	09°57'S	139°40'W	84.7	030	13	85.2	77.1	1008	02	8	2	8	3	060	1	35.90	0.26
224	0000	4/7	10°16'S	139°42'W	84.8	360	14	83.4	77.2	1007	02	8	2	8	3	060	1	35.93	0.30
225	0300	4/7	10°34'S	139°43'W	85.0	330	10	86.5	77.6	1008	03	8,5	5	8	2	060	1	35.95	0.30
226	0600	4/7	10°52'S	139°45'W	85.0	350	07	84.3	77.3	1010	00	X	X	8	2	050	1	36.08	0.65
227	0900	4/7	11°12'S	139°47'W	84.4	320	06	84.4	76.6	1010	03	4	5	7	1	050	1	36.00	0.34
228	1200	4/7	11°28'S	139°48'W	84.2	020	05	80.5	76.2	1008	00	X	3	7	2	050	1	36.02	0.35
229	1500	4/7	11°44'S	139°49'W	84.1	040	05	83.2	76.2	1010	03	4,8	5	7	2	050	1	36.01	0.36
230	1800	4/7	12°04'S	139°48'W	84.0	080	10	81.2	77.8	1011	60	7	8	7	2	140	4	36.01	0.35
231	2100	4/7	12°24'S	139°47'W	84.2	070	07	82.5	77.9	1010	20	7	7	7	2	140	1	35.87	0.30
232	0000	4/8	12°44'S	139°46'W	85.2	090	05	82.7	78.2	1008	01	8,4,2	3	8	2	120	1	35.92	0.30
233	0300	4/8	12°50'S	139°46'W	84.9	070	05	84.2	77.5	1008	02	8	3	8	2	120	1	35.94	0.30
234	0600	4/8	12°32'S	139°43'W	84.2	110	05	83.8	77.6	1010	00	X	X	7	2	150	1	35.95	0.30
235	0900	4/8	12°17'S	139°43'W	84.3	090	06	82.8	77.8	1011	00	X	X	7	2	150	1	35.99	0.36
236	1200	4/8	12°00'S	139°41'W	84.2	090	11	83.9	77.6	1010	00	X	X	7	2	150	1	36.01	0.38
237	1500	4/8	11°43'S	139°40'W	84.1	030	04	82.2	75.6	1010	02	8	2	8	1	150	1	36.02	0.36
238	1800	4/8	11°23'S	139°41'W	83.9	060	08	83.8	76.8	1012	01	2,8	2	8	2	150	1	36.00	0.36
239	2100	4/8	11°03'S	139°42'W	84.6	060	08	85.6	78.1	1010	02	8	2	8	2	150	1	36.02	0.62
240	0000	4/9	10°43'S	139°42'W	85.3	040	08	86.5	77.5	1008	01	8	2	8	2	150	1	35.96	0.34
241	0300	4/9	10°22'S	139°43'W	85.4	040	06	84.3	76.7	1009	02	8	1	8	2	150	1	36.01	0.35
242	0600	4/9	10°02'S	139°44'W	85.1	070	04	84.1	75.6	1010	00	X	X	7	2	150	1	35.97	0.29
243	0900	4/9	09°42'S	139°48'W	84.8	060	12	84.1	77.7	1011	03	8	5	7	2	150	1	35.91	0.32
244	1200	4/9	09°24'S	139°51'W	84.4	070	09	82.9	77.3	1010	01	8	2	8	2	150	1	35.94	0.36
245	1500	4/9	09°08'S	139°55'W	84.4	070	09	83.9	76.8	1010	02	8	2	8	2	150	1	35.88	0.18

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
246	2104	4/11	08°37'S	140°39'W	85.1	080	10	87.5	79.5	1010	02	8	2	8	2	010	1	-	-
247	2200	4/11	08°32'S	140°40'W	85.2	060	09	87.6	79.3	1010	02	8	3	8	2	010	1	35.92	0.31
248	0132	4/12	08°12'S	140°40'W	85.1	080	11	84.2	78.0	1009	14	9	3	8	2	010	1	35.94	0.62
249	2200	4/12	07°50'S	140°06'W	85.2	100	11	85.4	77.8	1010	03	8	4	8	2	060	1	35.94	0.49
250	0014	4/13	07°55'S	140°00'W	85.3	090	11	85.1	77.6	1009	02	8	3	8	2	060	1	-	-
251	2200	4/13	08°44'S	139°32'W	84.6	100	14	83.5	76.2	1011	01	8	2	8	3	100	4	35.87	0.49
252	2200	4/14	09°34'S	138°54'W	84.5	070	21	XXX	XXX	1012	60	7	8	6	3	090	4	35.99	0.41
253	2200	4/15	10°12'S	138°50'W	84.4	100	14	84.1	77.3	1010	03	8	7	8	3	080	4	36.04	0.50
254	2200	4/17	09°33'S	139°50'W	85.0	080	09	87.5	79.9	1012	01	8	2	8	2	060	1	35.95	0.58
255	0000	4/18	09°34'S	139°49'W	85.2	080	09	86.4	79.0	1010	02	8	3	8	2	060	1	-	-
256	0200	4/18	09°34'S	139°49'W	85.0	070	11	84.2	78.3	1010	25	7,4	6	7	2	070	1	-	-
257	0400	4/18	09°34'S	139°48'W	84.7	050	08	83.8	77.9	1012	00	X	X	7	2	060	1	-	-
258	0600	4/18	09°33'S	139°50'W	84.5	050	12	83.8	77.1	1013	00	X	X	7	2	060	1	-	-
259	0800	4/18	09°32'S	139°53'W	84.6	120	08	83.3	78.5	1013	80	X	X	7	2	060	1	-	-
260	1000	4/18	09°32'S	139°52'W	84.6	070	10	83.2	78.0	1012	00	X	X	7	2	060	1	-	-
261	1200	4/18	09°33'S	139°52'W	84.6	070	11	82.8	77.5	1011	00	X	X	7	2	060	1	-	-
262	1400	4/18	09°35'S	139°52'W	84.4	070	21	80.6	77.0	1012	00	X	X	7	2	060	1	-	-
263	1600	4/18	09°34'S	139°52'W	84.4	070	08	81.8	76.3	1012	01	6	2	8	2	060	1	-	-
264	1800	4/18	09°33'S	139°51'W	84.4	080	08	83.2	78.2	1013	02	8	1	8	2	080	1	-	-
265	2000	4/18	09°34'S	139°51'W	84.7	080	13	85.1	78.6	1013	03	8	3	8	2	080	1	-	-
266	2147	4/18	09°32'S	139°52'W	85.0	090	05	86.1	78.5	1012	01	8	2	8	2	080	1	-	-
267	0000	4/22	08°44'S	140°22'W	85.4	260	03	88.5	80.9	1011	03	8	3	8	2	060	1	35.94	0.50
268	0305	4/22	08°23'S	140°38'W	84.8	100	16	84.1	79.8	1011	02	8	2	8	2	070	1	-	-
269	0600	4/22	08°02'S	140°50'W	84.9	080	14	84.4	79.8	1013	00	X	X	7	2	070	1	35.91	0.50
270	0900	4/22	07°46'S	140°58'W	84.8	080	15	83.9	79.7	1012	00	X	X	7	2	070	1	-	-
271	1200	4/22	07°26'S	141°10'W	84.7	090	13	84.4	79.3	1011	00	X	X	7	2	070	1	35.88	0.47
272	1500	4/22	07°06'S	141°22'W	84.7	100	17	83.3	78.0	1011	00	X	X	7	3	070	1	-	-
273	1800	4/22	06°46'S	141°34'W	84.7	090	15	84.5	79.1	1013	02	8	2	8	3	070	1	35.85	0.63
274	2100	4/22	06°26'S	141°46'W	84.8	100	11	86.6	80.0	1012	03	8	3	8	3	090	1	-	-
275	0000	4/23	06°05'S	141°58'W	84.6	110	10	84.3	81.4	1009	02	8	2	8	3	100	1	35.57	0.65
276	0300	4/23	05°42'S	142°12'W	84.4	110	11	83.5	80.0	1009	02	8	3	8	3	100	1	-	-
277	0600	4/23	05°21'S	142°26'W	84.2	080	10	82.8	79.5	1010	00	X	X	8	3	100	1	35.43	0.56
278	0900	4/23	05°04'S	142°34'W	83.5	070	11	82.3	79.2	1010	60	X	X	8	3	090	1	-	-
279	1200	4/23	04°41'S	142°46'W	83.3	060	08	80.0	78.1	1009	00	X	X	8	2	090	1	35.17	0.45
280	1500	4/23	04°19'S	142°58'W	83.4	050	13	83.2	78.8	1009	03	8	3	8	2	090	1	-	-

Table 4. --Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
281	1800	4/23	03°58'S	143°13'W	83.4	050	11	84.5	79.8	1012	03	4,8	5	8	2	060	1	35.13	0.50
282	2100	4/23	03°38'S	143°27'W	84.0	050	07	85.4	79.9	1011	02	8	6	8	2	080	1	-	-
283	0000	4/24	03°16'S	143°42'W	83.7	020	10	83.4	78.6	1009	14	9,4	7	8	2	080	1	35.08	0.60
284	0300	4/24	02°55'S	143°57'W	83.3	270	07	80.7	77.4	1009	14	9	7	7	2	080	1	-	-
285	0600	4/24	02°34'S	144°12'W	83.0	250	03	80.8	77.8	1010	00	X	X	7	2	080	1	35.14	0.54
286	0900	4/24	02°16'S	144°24'W	84.0	270	03	81.3	77.6	1010	00	X	X	7	2	080	1	-	-
287	1200	4/24	01°54'S	144°37'W	83.1	030	04	82.2	77.1	1008	00	X	X	7	2	080	1	35.19	0.59
288	1500	4/24	01°33'S	144°50'W	82.9	090	07	81.6	76.7	1008	00	8	2	8	2	080	1	-	-
289	1800	4/24	01°11'S	145°06'W	82.7	090	07	83.0	78.1	1010	02	8	2	8	2	080	1	35.23	0.61
290	2100	4/24	00°49'S	145°20'W	83.2	100	07	85.9	78.9	1010	01	8	2	8	2	080	1	-	-
291	0000	4/25	00°25'S	145°32'W	83.8	100	05	84.0	78.1	1007	02	8	1	8	2	080	1	35.36	0.69
292	0300	4/25	00°00'	145°44'W	83.2	110	09	84.4	78.3	1007	02	4	2	8	2	080	1	-	-
293	0600	4/25	00°22'N	145°57'W	82.5	100	08	82.2	78.1	1008	00	X	X	8	2	080	1	35.37	0.60
294	0900	4/25	00°42'N	146°08'W	82.5	130	11	83.3	78.5	1010	00	X	X	7	2	080	1	-	-
295	1200	4/25	01°04'N	146°21'W	82.3	130	14	81.9	78.2	1008	00	X	X	7	2	080	1	35.18	0.84
296	1500	4/25	01°26'N	146°34'W	82.6	130	12	82.8	78.8	1008	03	8	2	7	2	080	1	-	-
297	1800	4/25	01°48'N	146°49'W	82.7	120	13	84.4	80.0	1009	03	8,4	4	8	2	080	1	34.98	0.52
298	2100	4/25	02°08'N	147°04'W	83.0	120	08	84.5	80.1	1008	03	8	6	8	2	080	1	-	-
299	0000	4/26	02°28'N	147°17'W	83.8	120	09	84.0	80.3	1007	02	8,5	5	8	2	080	1	34.84	0.40
300	0300	4/26	02°52'N	147°28'W	83.8	XXX	XX	83.2	78.3	1007	02	8,5	6	8	2	080	1	-	-
301	0600	4/26	03°15'N	147°40'W	83.4	180	09	83.3	78.6	1009	00	X	X	7	2	080	1	34.72	0.34
302	0900	4/26	03°33'N	147°50'W	83.2	220	08	82.6	78.7	1009	00	X	X	8	2	080	1	-	-
303	1200	4/26	03°55'N	148°02'W	82.5	340	09	80.2	77.9	1008	60	X	X	7	2	080	1	34.19	0.33
304	1500	4/26	04°16'N	148°14'W	82.1	290	06	XXX	XXX	1009	62	X	X	6	2	080	1	-	-
305	1800	4/26	04°37'N	148°26'W	81.5	360	06	79.4	76.6	1010	50	5,4,7	7	7	2	030	1	34.64	0.44
306	2100	4/26	04°58'N	148°38'W	82.3	020	15	83.3	77.7	1011	03	6,8	8	8	2	030	1	-	-
307	0000	4/27	05°18'N	148°47'W	82.5	070	18	81.5	78.2	1008	14	6,4,8	8	7	3	040	1	34.61	0.49
308	0300	4/27	05°41'N	148°57'W	82.3	050	15	81.4	77.2	1008	03	5,6	7	7	3	040	4	-	-
309	0600	4/27	06°02'N	149°07'W	82.2	080	13	80.2	77.1	1010	00	X	X	7	4	030	4	34.61	0.42
310	0900	4/27	06°20'N	149°15'W	82.0	060	13	81.5	78.0	1010	80	9	7	7	3	040	4	-	-
311	1200	4/27	06°42'N	149°26'W	82.0	060	13	80.2	78.6	1008	00	X	X	7	3	040	4	34.72	0.44
312	1500	4/27	07°05'N	149°37'W	81.5	060	18	82.0	78.1	1009	00	X	X	7	3	040	4	-	-
313	1800	4/27	07°24'N	149°52'W	81.5	050	19	79.6	77.7	1011	60	7,8,5	8	6	4	040	4	34.69	0.35
314	2100	4/27	07°44'N	150°07'W	81.2	060	20	79.5	77.8	1011	50	7,5	8	6	4	040	4	-	-
315	0000	4/28	08°05'N	150°20'W	81.1	060	18	83.1	78.4	1009	21	7,5,8	7	6	4	040	4	34.82	0.50

Table 4.--Observations at bathythermograph lowerings, Charles H. Gilbert cruise 38 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
316	0300	4/28	08°29'N	150°32'W	81.1	050	19	80.9	77.5	1009	14	7,5	8	6	4	040	4	-	-
317	0600	4/28	08°51'N	150°45'W	81.0	060	17	80.0	77.0	1010	00	X	X	6	4	040	4	34.74	0.35
318	0900	4/28	09°12'N	150°58'W	81.0	060	20	81.1	76.3	1010	00	X	X	6	4	040	4	-	-
319	1200	4/28	09°32'N	151°10'W	80.9	080	20	79.5	76.3	1009	00	X	X	6	4	040	4	34.75	0.31
320	1500	4/28	09°52'N	151°22'W	80.7	070	18	79.7	76.1	1009	00	X	X	6	4	040	4	-	-
321	1800	4/28	10°14'N	151°38'W	80.4	060	16	79.0	76.2	1011	03	8,1	2	7	4	040	4	34.85	0.27
322	2100	4/28	10°35'N	151°53'W	80.2	070	18	81.3	76.7	1011	02	8	4	8	4	040	4	-	-
323	0000	4/29	10°58'N	152°06'W	80.5	070	16	81.2	77.0	1010	02	8	5	8	4	050	4	34.88	0.34
324	0600	4/29	11°44'N	152°31'W	80.0	060	16	79.8	75.6	1012	00	X	X	7	3	050	4	34.81	0.44
325	1200	4/29	12°24'N	152°54'W	79.3	070	19	78.0	74.6	1010	00	X	X	8	3	050	4	34.79	0.67
326	1800	4/29	13°08'N	153°20'W	79.0	080	16	78.9	74.0	1013	03	8,4	5	8	3	050	4	34.69	0.34
327	0000	4/30	13°52'N	153°45'W	78.2	080	14	79.4	73.6	1012	03	5,4	7	7	3	050	4	34.57	0.34
328	0600	4/30	14°40'N	154°09'W	77.9	080	15	77.7	73.1	1013	00	X	X	7	3	050	4	34.69	0.28
329	1200	4/30	15°21'N	154°28'W	77.5	060	17	76.0	73.1	1013	00	X	X	7	3	050	4	34.65	0.34
330	1800	4/30	16°09'N	154°52'W	77.3	060	19	77.1	73.2	1015	03	6	7	7	3	050	4	34.63	0.33
331	0000	5/1	16°57'N	155°16'W	77.0	060	15	78.5	72.3	1014	02	6,1	5	8	3	050	4	34.67	0.38
332	0600	5/1	17°42'N	155°40'W	76.6	060	18	75.9	71.7	1015	00	X	X	7	3	050	4	34.64	0.35
333	1200	5/1	18°18'N	155°59'W	75.5	070	22	74.2	70.5	1014	00	8	1	8	4	050	4	34.76	0.29
334	1800	5/1	19°03'N	156°23'W	76.8	230	04	75.5	70.7	1016	03	6	3	7	3	160	1	34.62	0.32
335	0000	5/2	19°49'N	156°44'W	76.3	060	16	77.1	72.2	1015	01	8,2	2	8	3	040	1	34.88	0.28
336	0600	5/2	20°45'N	157°15'W	76.7	080	12	76.4	70.4	1015	80	6	4	8	3	080	1	34.76	0.29

Table 5.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
1	0002	3/30	19°03'N	155°59'W	76.2	170	12	78.0	68.4	1017	15	1,2,6,4	6	7	2	140	1	-	-
2	0603	3/30	18°29'N	155°22'W	74.4	020	28	73.8	68.0	1018	02	6	7	6	4	080	4	-	-
3	1205	3/30	18°03'N	154°53'W	74.6	060	21	73.0	68.3	1018	01	8	2	6	X	060	1	-	-
4	1810	3/30	17°26'N	154°41'W	75.7	060	20	74.5	69.8	1018	01	8	2	7	4	060	1	-	-
5	0010	3/31	16°45'N	153°41'W	75.5	070	20	76.0	70.8	1016	15	9,8,1	3	6	4	040	1	-	-
6	0602	3/31	16°12'N	153°05'W	75.3	070	24	71.8	70.2	1017	18	9	8	5	4	060	4	-	-
7	1200	3/31	15°48'N	152°33'W	75.6	080	28	73.7	69.7	1017	15	9,8,2	5	6	2	040	4	-	-
8	1805	3/31	15°20'N	152°00'W	76.2	060	26	75.1	69.7	1017	02	8	2	7	4	040	4	-	-
9	0000	4/1	14°46'N	151°35'W	76.7	060	27	77.0	71.5	1015	15	1,3,8,9	7	6	5	060	4	-	-
10	0600	4/1	14°14'N	151°00'W	77.1	070	27	74.5	71.3	1016	02	8	4	6	5	070	4	-	-
11	1205	4/1	13°47'N	150°28'W	77.4	070	24	75.2	70.5	1015	01	8,6	2	6	5	080	4	-	-
12	1805	4/1	13°15'N	149°54'W	77.4	070	26	76.8	72.0	1015	15	8,6	6	7	5	070	4	-	-
13	0010	4/2	12°44'N	149°20'W	79.0	070	25	77.5	73.5	1012	16	1,4,8,9	6	6	4	080	4	-	-
14	0600	4/2	12°11'N	148°46'W	79.2	080	24	77.0	73.1	1014	18	6	6	6	5	080	4	-	-
15	1205	4/2	11°44'N	148°15'W	79.6	070	27	77.2	73.0	1012	02	1,3,8	6	6	4	080	4	-	-
16	1800	4/2	11°12'N	147°42'W	79.0	070	24	78.1	72.2	1013	03	1,3,6,8	2	6	4	070	4	-	-
17	0000	4/3	10°39'N	147°08'W	80.1	050	24	79.0	73.5	1012	01	1,4,8	2	6	4	060	4	-	-
18	0605	4/3	10°08'N	146°29'W	78.5	070	24	78.1	73.2	1013	03	8,6	4	7	4	070	4	-	-
19	1200	4/3	09°42'N	145°56'W	78.5	050	25	78.0	73.1	1012	03	8,4	7	6	3	090	1	-	-
20	1800	4/3	09°10'N	145°18'W	79.0	050	24	78.8	74.1	1012	01	8,6	6	6	3	050	4	-	-
21	2345	4/3	08°38'N	144°50'W	80.0	050	25	79.5	74.0	1010	03	1,6,8	7	6	5	060	4	-	-
22	0600	4/4	08°05'N	144°11'W	80.4	050	20	78.2	75.2	1012	02	6	8	6	5	060	4	-	-
23	1200	4/4	07°38'N	143°38'W	80.8	060	26	78.8	75.2	1010	02	6	8	6	4	040	4	-	-
24	1805	4/4	07°06'N	143°01'W	81.6	050	24	81.6	76.6	1012	02	4,1,6,8	4	6	5	070	4	-	-
25	0000	4/5	06°36'N	142°22'W	81.8	060	25	81.0	78.0	1008	25	6,8	8	5	3	060	4	-	-
26	0600	4/5	06°08'N	141°42'W	82.0	040	16	80.0	77.5	1010	52	6	8	5	5	060	4	-	-
27	1210	4/5	05°44'N	141°01'W	81.7	060	18	80.3	78.0	1007	50	8	8	5	3	070	1	-	-
28	1810	4/5	05°17'N	140°20'W	81.5	110	13	81.2	78.0	1010	51	4,6,8	8	6	3	080	1	-	-
29	0000	4/6	04°37'N	140°00'W	83.8	010	20	81.5	78.0	1007	20	6,8	7	6	4	080	1	-	-
243	0600	4/29	04°17'S	142°51'W	82.9	130	18	82.8	78.5	1009	03	9,8	5	6	2	150	1	-	-
244	1130	4/29	05°04'S	143°18'W	83.2	140	14	83.0	78.0	1008	02	8	2	6	2	XXX	1	-	-
245	1800	4/29	05°53'S	143°49'W	83.8	100	16	83.0	74.9	1010	15	6,1,8,4,9	5	6	2	110	1	-	-
246	2330	4/29	06°45'S	144°15'W	84.2	120	18	84.5	78.0	1007	15	8,9	2	6	2	140	1	-	-
247	0530	4/30	07°36'S	144°40'W	84.6	100	20	84.1	77.0	1010	01	8	2	6	2	150	1	-	-
248	1300	4/30	08°46'S	145°12'W	84.6	100	16	84.0	78.0	1008	80	8,9	7	6	3	140	1	-	-
249	1800	4/30	09°28'S	145°32'W	84.8	110	18	85.0	78.0	1011	01	8,9,1	3	6	3	110	1	-	-
250	2330	4/30	10°17'S	145°55'W	84.6	100	14	84.0	78.1	1008	02	8	2	6	2	120	1	-	-

Table 5.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
251	0600	5/1	11°14'S	146°21'W	84.3	100	14	84.0	78.0	1010	02	8	1	6	2	120	1	-	-
252	1120	5/1	12°02'S	146°44'W	84.0	110	14	83.2	76.5	1010	02	8	1	6	2	130	1	-	-
253	1800	5/1	12°54'S	147°17'W	83.9	090	14	83.5	78.5	1011	02	8,9	1	6	2	120	1	-	-
254	2330	5/1	13°32'S	147°58'W	84.0	120	16	84.1	78.0	1010	02	8,9	2	6	2	130	1	-	-
255	0600	5/2	14°19'S	148°45'W	84.2	120	12	83.5	77.5	1010	02	8	1	6	2	090	1	-	-
256	1135	5/2	15°14'S	149°01'W	83.7	140	14	82.6	76.8	1010	02	8	1	6	2	100	1	-	-
257	1800	5/2	16°30'S	149°15'W	83.8	090	14	83.5	77.6	1012	02	8,9	1	6	2	060	1	-	-
258	2335	5/2	17°04'S	149°28'W	83.9	100	16	83.0	76.8	1010	02	1,8,9	3	6	2	090	1	-	-
259	1800	5/7	17°35'S	149°02'W	82.8	040	23	79.4	75.6	1010	02	0	8	6	3	040	1	-	-
260	2355	5/7	16°58'S	148°26'W	83.1	010	18	82.5	74.9	1008	02	0	7	6	3	010	1	-	-
261	0603	5/8	16°18'S	147°52'W	83.1	010	23	83.0	76.3	1011	80	6	8	6	3	010	1	-	-
262	1200	5/8	15°58'S	147°36'W	83.1	020	16	82.5	74.8	1010	01	1,2,4,8	7	6	1	010	1	-	-
263	1800	5/8	15°42'S	147°22'W	83.4	020	18	83.2	76.8	1010	01	4,8	5	6	2	020	1	-	-
264	2355	5/8	14°59'S	146°46'W	83.7	020	12	83.8	75.5	1009	01	4,8	3	6	2	030	1	-	-
265	0600	5/9	14°14'S	146°16'W	83.3	050	12	83.0	76.3	1010	01	4,8	2	7	2	040	1	-	-
266	1200	5/9	13°40'S	145°34'W	83.6	060	15	83.0	76.3	1008	02	4,8	3	6	2	050	1	-	-
267	1800	5/9	13°05'S	144°52'W	83.2	050	14	84.5	77.2	1011	02	8,6	1	6	2	060	1	-	-
268	0000	5/10	12°31'S	144°11'W	84.0	070	10	83.9	76.0	1008	02	8	1	6	2	060	1	-	-
269	0600	5/10	11°57'S	143°32'W	84.5	100	14	83.3	78.2	1010	01	8	1	7	2	060	1	-	-
270	1200	5/10	11°24'S	142°54'W	83.0	110	14	82.5	77.0	1009	00	8	1	6	2	090	1	-	-
271	1800	5/10	10°49'S	142°16'W	83.2	100	18	83.7	75.2	1012	02	8	1	6	3	100	1	-	-
272	0000	5/11	10°18'S	141°40'W	84.0	110	18	84.5	76.2	1007	03	8	2	6	3	100	1	-	-
273	0600	5/11	09°47'S	141°00'W	83.8	110	17	83.0	78.0	1009	01	8	2	7	3	100	3	-	-
274	1200	5/11	09°15'S	140°18'W	83.0	070	12	80.0	76.8	1008	02	8	1	6	3	080	3	-	-
275	1500	5/15	09°12'S	139°38'W	82.8	070	14	82.0	76.2	1010	02	8	1	7	2	070	1	35.90	0.59
276	1800	5/15	09°12'S	139°17'W	83.1	090	12	82.9	76.6	1012	03	8	2	6	2	090	1	35.88	0.56
277	2100	5/15	09°14'S	138°58'W	83.1	100	12	83.0	76.8	1010	02	8	2	7	2	090	1	36.02	0.74
278	0010	5/16	09°08'S	138°40'W	83.1	130	14	82.8	77.0	1008	02	8,1,2	2	6	2	100	1	35.94	0.57
279	0300	5/16	09°07'S	138°24'W	82.8	130	13	82.5	77.5	1008	02	8,1,2	2	7	2	100	1	36.15	0.62
280	0632	5/16	09°08'S	138°04'W	82.6	110	16	82.2	76.0	1010	02	8	1	7	2	120	1	35.91	0.61
281	0900	5/16	09°10'S	137°46'W	82.4	110	14	81.7	76.0	1010	02	8	1	7	2	120	1	35.92	0.58
282	1200	5/16	09°12'S	137°22'W	82.4	100	10	81.6	75.7	1009	02	8	1	6	2	100	1	35.97	0.49
283	1503	5/16	09°14'S	137°06'W	82.3	110	08	81.3	75.2	1010	02	8,1	2	7	2	090	1	35.89	0.58
284	1810	5/16	09°10'S	136°47'W	82.8	110	13	82.2	76.2	1012	02	8,5	2	6	2	110	1	35.90	0.59
285	2100	5/16	09°10'S	136°27'W	82.8	100	12	82.8	75.4	1010	02	8,5	2	7	2	110	1	35.92	0.55

Table 5. --Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
286	0000	5/17	09°10'S	136°06'W	82.7	100	12	82.5	75.2	1010	03	4,2,8	2	7	3	090	1	35.96	0.59
287	0105	5/17	09°05'S	136°07'W	82.7	100	13	82.7	75.5	1009	03	1,2,8	4	7	3	100	1	35.91	0.37
288	0300	5/17	09°09'S	135°53'W	82.6	130	08	82.0	75.5	1010	03	1,2,8	4	7	3	100	1	35.94	0.59
289	0600	5/17	09°10'S	136°08'W	82.5	090	14	82.1	75.0	1012	02	1	2	7	2	090	1	35.93	0.69
290	0900	5/17	09°12'S	136°34'W	82.6	100	11	81.5	76.0	1012	02	X	1	7	2	090	1	35.95	0.59
291	1203	5/17	09°13'S	137°02'W	82.6	080	10	81.2	75.5	1010	02	8	1	7	2	090	1	35.91	0.58
292	1500	5/17	09°14'S	137°20'W	82.7	090	13	81.6	74.8	1011	02	8,1	1	6	2	070	1	35.88	0.54
293	1800	5/17	09°14'S	137°43'W	82.8	080	14	82.9	74.9	1012	03	8,1	2	6	2	090	1	35.88	0.20
294	2100	5/17	09°16'S	138°03'W	83.0	090	12	83.0	75.8	1011	02	8	2	6	2	090	1	35.89	0.55
295	2355	5/17	09°14'S	138°28'W	83.2	080	08	XXX	76.8	1009	02	8,1	2	7	2	080	1	35.92	0.63
296	0300	5/18	09°12'S	138°51'W	82.9	090	12	82.7	75.7	1009	03	8,1	3	6	2	090	1	35.92	-
297	0610	5/18	09°12'S	139°04'W	82.8	130	12	82.2	75.5	1011	01	8	1	8	2	100	1	36.12	0.69
298	1500	5/19	09°12'S	139°40'W	82.7	110	18	81.8	75.0	1012	02	8	2	7	2	080	1	35.91	0.55
299	1800	5/19	09°12'S	140°04'W	83.1	100	18	82.9	75.3	1013	02	8,6	2	8	2	080	1	35.90	0.42
300	2100	5/19	09°16'S	140°28'W	83.5	090	20	83.8	76.2	1013	02	8	2	8	2	100	1	35.94	-
301	0000	5/20	09°14'S	140°49'W	83.6	100	10	83.8	76.2	1010	02	8,1	2	7	2	100	1	35.94	-
302	0300	5/20	09°12'S	141°08'W	83.7	090	19	83.0	76.5	1010	03	2,8,1	2	6	2	080	1	36.00	-
303	0600	5/20	09°12'S	141°19'W	83.2	120	17	83.2	77.0	1012	02	X	2	7	2	080	1	35.92	-
304	0900	5/20	09°12'S	141°39'W	83.6	140	14	83.2	76.0	1012	02	X	2	7	2	080	1	35.91	-
305	1200	5/20	09°12'S	142°02'W	83.8	100	14	82.4	75.3	1010	02	8	2	7	2	100	1	35.85	0.53
306	1500	5/20	09°12'S	142°16'W	83.7	100	14	82.5	75.4	1012	03	8,6	5	7	2	100	1	35.88	0.48
307	1825	5/20	09°18'S	142°38'W	84.0	070	12	83.8	76.3	1013	01	4,8	1	6	2	100	1	36.10	-
308	2100	5/20	09°17'S	142°54'W	84.2	090	14	83.9	76.3	1012	01	4,8	1	6	2	100	1	-	-
309	0000	5/21	09°14'S	143°14'W	84.3	070	11	XXX	77.3	1009	02	8,3	1	7	2	070	1	35.88	0.48
310	0300	5/21	09°11'S	143°22'W	84.2	090	12	83.9	76.3	1009	15	6,9,8	3	6	2	090	1	35.90	-
311	0605	5/21	09°12'S	143°06'W	84.0	100	12	83.6	77.2	1010	02	X	3	6	2	090	1	35.89	-
312	0900	5/21	09°13'S	142°44'W	83.8	120	14	82.5	77.2	1011	02	X	3	6	2	090	1	35.91	0.52
313	1200	5/21	09°14'S	142°22'W	83.0	120	14	81.0	76.0	1010	64	X	4	6	2	090	1	35.93	-
314	1500	5/21	09°15'S	142°05'W	83.4	080	18	82.4	75.7	1010	03	8,4	1	7	3	090	1	35.94	0.53
315	1800	5/21	09°15'S	141°43'W	83.8	080	10	83.3	75.8	1011	02	8,6	1	6	2	090	1	35.91	0.37
316	2100	5/21	09°14'S	141°21'W	84.0	130	15	81.5	78.4	1010	15	8,6	6	6	2	100	1	35.91	0.26
317	2240	5/21	09°14'S	141°13'W	83.8	130	10	81.0	76.8	1009	95	8,6	7	6	2	110	1	35.89	0.53
318	0005	5/22	09°14'S	141°04'W	83.5	100	12	82.8	77.7	1008	91	9,6	6	6	2	100	1	35.91	0.53
319	0300	5/22	09°13'S	140°50'W	83.2	090	18	81.8	76.8	1008	15	9,6,1,3	3	7	2	090	1	35.87	-
320	0615	5/22	09°12'S	140°34'W	82.8	100	20	80.3	76.5	1008	81	6	4	7	3	090	1	35.89	0.53

Table 5. --Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
321	0900	5/22	09°12'S	140°14'W	82.7	110	14	82.4	76.5	1008	02	8	2	7	3	110	1	35.86	0.55
322	1500	5/23	09°12'S	139°40'W	82.3	090	12	81.2	74.0	1010	02	8	1	7	2	090	1	35.90	0.59
323	1800	5/23	08°48'S	139°40'W	82.8	090	12	82.7	74.3	1011	03	1,8	5	7	2	090	1	35.89	0.27
324	2100	5/23	08°24'S	139°40'W	83.1	080	14	83.0	75.3	1009	03	1,2,8	6	7	2	090	1	35.89	0.73
325	0000	5/24	08°09'S	139°42'W	83.2	090	14	82.7	75.5	1008	02	2,8	3	7	3	080	2	35.81	0.63
326	0300	5/24	07°52'S	139°45'W	82.9	090	13	82.6	74.8	1008	02	2,8	4	7	2	090	1	35.74	0.61
327	0610	5/24	07°39'S	139°42'W	82.7	060	12	81.7	75.3	1009	01	8	1	7	2	080	1	35.30	0.69
328	0900	5/24	07°18'S	139°42'W	82.3	070	13	80.0*	75.5	1010	02	8	1	7	2	080	1	34.94	0.63
329	1200	5/24	06°54'S	139°41'W	82.3	070	11	80.5	75.5	1009	02	X	1	7	1	080	1	35.02	0.54
330	1500	5/24	06°38'S	139°39'W	82.3	070	09	80.8	75.3	1010	03	8,1	4	7	1	070	1	34.97	0.53
331	1620	5/24	06°31'S	139°39'W	82.4	070	08	81.9	74.8	1010	03	1,2,8	5	6	1	080	1	35.05	0.57
332	2110	5/24	05°58'S	139°36'W	83.4	100	05	83.3*	75.2	1009	01	1,2,8	2	6	1	080	1	35.13	0.68
333	0003	5/25	05°42'S	139°37'W	83.8	070	06	82.3	75.3	1008	02	8	1	6	1	070	1	-	0.59
334	0250	5/25	05°25'S	139°40'W	83.3	120	07	82.0	75.3	1008	03	8,2	4	6	1	100	1	35.15	0.60
335	0618	5/25	05°38'S	139°38'W	82.7	100	07	81.7	74.2	1010	02	8	1	6	1	100	1	35.13	0.64
336	0900	5/25	06°00'S	139°38'W	82.7	100	04	81.2	74.0	1010	02	8	1	7	1	100	1	35.17	0.59
337	1200	5/25	06°24'S	139°38'W	82.7	000	00	81.0	74.8	1010	03	8,1	2	6	1	100	1	35.01	0.57
338	1505	5/25	06°43'S	139°39'W	82.2	140	18	XXX	75.0	1012	63	7	8	5	2	140	1	34.92	0.63
339	1800	5/25	07°04'S	139°40'W	82.4	080	15	79.8	75.2	1012	15	8,6	7	6	2	090	1	34.96	0.60
340	1920	5/25	07°11'S	139°42'W	82.6	080	06	81.9	73.3	1012	15	8,6	7	6	2	090	1	34.97	0.62
341	2100	5/25	07°24'S	139°42'W	83.0	080	05	81.7	75.2	1010	15	6,9,8	2	6	2	100	1	35.43	0.74
342	2340	5/25	07°42'S	139°40'W	83.2	230	07	80.9	75.3	1009	15	8,9,6	7	6	2	100	1	35.75	0.63
343	0300	5/26	08°08'S	139°42'W	83.2	070	05	81.3	75.3	1010	01	8,6	2	6	2	090	1	35.90	0.73
344	0600	5/26	08°26'S	139°40'W	82.9	120	07	81.6	74.1	1011	02	8	2	6	1	090	1	35.88	0.64
345	0900	5/26	08°48'S	139°40'W	83.0	120	06	81.0	73.6	1011	02	8	2	7	1	090	1	-	-
346	1502	5/27	09°14'S	139°40'W	82.3	070	16	80.8	74.7	1011	02	8,4	1	7	2	070	1	35.88	0.47
347	1800	5/27	09°37'S	139°40'W	82.9	080	22	81.9	73.3	1012	03	1,8,6	2	6	2	090	1	-	-
348	2100	5/27	10°00'S	139°40'W	83.0	080	18	82.7	75.3	1012	02	1,8,6	2	7	2	120	1	35.91	0.55
349	0000	5/28	10°20'S	139°40'W	83.2	050	13	82.2	74.8	1009	03	6,8	5	6	2	070	1	35.95	0.57
350	0300	5/28	10°41'S	139°40'W	82.9	050	18	82.7	75.3	1010	01	1,8	2	6	2	070	1	35.91	0.59
351	0608	5/28	10°54'S	139°38'W	82.7	050	16	82.0	75.8	1011	01	8	1	6	2	070	1	35.93	0.59
352	0900	5/28	11°12'S	139°39'W	82.7	030	17	81.3	76.1	1011	02	8	1	7	2	040	1	35.95	0.49
353	1200	5/28	11°30'S	139°39'W	82.8	060	12	81.7	76.8	1010	02	8	1	6	1	050	1	36.00	0.46
354	1500	5/28	11°45'S	139°40'W	82.6	030	16	81.3	75.8	1011	02	8	2	7	1	030	1	36.04	0.48
355	1800	5/28	12°04'S	139°41'W	82.7	020	13	82.8	76.2	1013	02	8	2	6	2	010	1	-	-

*Questionable

Table 5.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
356	1850	5/28	12°08'S	139°42'W	82.8	020	14	82.7	76.2	1013	15	9,8	2	6	2	010	1	36.04	0.26
357	2100	5/28	12°20'S	139°43'W	82.8	020	17	82.7	76.7	1012	03	6,1,2,9,8	4	6	2	010	1	36.06	0.27
358	0005	5/29	12°38'S	139°41'W	82.9	020	16	83.8*	77.2	1011	02	1,8	6	7	2	020	1	36.06	0.47
359	0300	5/29	12°56'S	139°38'W	82.8	360	12	82.7	76.7	1011	02	1,8	6	6	2	360	1	36.06	0.62
360	0600	5/29	12°38'S	139°39'W	82.5	350	10	82.5	76.0	1013	02	8	4	7	2	020	1	36.08	0.60
361	0900	5/29	12°20'S	139°39'W	82.2	350	10	82.0	75.7	1013	02	8	3	7	2	360	1	36.09	0.58
362	1155	5/29	11°58'S	139°40'W	82.8	020	15	81.2	75.6	1011	02	6,8	4	7	2	020	1	36.09	0.49
363	1500	5/29	11°40'S	139°40'W	82.3	010	12	81.5	75.0	1012	01	8	3	7	2	360	1	36.09	0.58
364	1800	5/29	11°18'S	139°41'W	82.8	020	09	82.6	75.7	1013	02	8	2	6	2	020	1	36.02	0.48
365	1905	5/29	11°10'S	139°44'W	82.8	020	13	82.7	75.2	1012	02	8,1	2	6	2	020	1	36.02	0.58
366	2100	5/29	10°55'S	139°45'W	83.2	020	12	83.4	75.7	1012	03	8,1	3	6	2	020	1	35.97	0.52
367	0000	5/30	10°42'S	139°42'W	83.4	010	08	82.8	74.8	1010	02	8,1	3	7	2	020	1	35.93	0.59
368	0300	5/30	10°24'S	139°36'W	83.4	030	07	83.2	74.3	1010	01	2,8,1	3	7	1	020	1	35.91	0.58
369	0605	5/30	10°08'S	139°34'W	83.3	020	03	82.2	74.6	1012	02	8,2	3	7	1	020	1	35.97	0.49
370	0900	5/30	09°48'S	139°34'W	82.8	040	10	81.6	75.4	1012	01	8	1	7	1	030	1	35.95	0.41
371	1200	5/30	09°25'S	139°34'W	82.6	050	11	81.0	75.2	1011	02	8	4	7	1	020	1	35.95	0.52
372	1925	6/1	08°43'S	140°33'W	83.1	040	18	82.9	76.2	1012	01	6,8,9	5	7	2	050	1	35.93	0.79
373	2100	6/1	08°29'S	140°38'W	83.3	040	16	82.9	75.2	1010	01	6,8,9	2	7	2	070	1	35.93	0.89
374	2100	6/2	07°45'S	140°12'W	83.3	050	14	82.8	74.2	1011	01	8	1	7	1	050	1	35.59	0.49
375	2255	6/2	07°45'S	140°02'W	83.3	090	10	82.4	74.7	1009	02	6,8,9	2	7	2	060	1	35.93	0.51
376	2100	6/3	08°40'S	139°20'W	82.8	080	14	83.5	75.2	1010	01	8	1	7	2	080	1	-	-
377	2150	6/5	09°28'S	138°54'W	82.8	090	16	83.0	77.2	1011	03	8	3	7	3	100	1	35.95	-
378	2100	6/7	10°19'S	138°30'W	82.8	090	18	83.6	75.4	1012	01	8,1	1	7	3	100	3	35.95	-
379	2100	6/8	09°48'S	139°29'W	83.0	060	14	83.3	75.5	1012	02	8,1	2	7	2	090	1	35.97	-
380	0105	6/9	09°34'S	139°48'W	83.3	050	07	82.9	74.8	1010	03	1,8,2	2	7	2	100	1	-	-
381	0255	6/9	09°34'S	139°49'W	83.1	070	12	82.2	75.2	1011	03	1,8,2	3	7	2	070	1	-	-
382	0510	6/9	09°34'S	139°48'W	82.8	090	12	82.2	75.2	1012	02	8,2	2	7	2	090	1	-	-
383	0700	6/9	09°34'S	139°50'W	82.8	090	12	82.6	75.5	1012	02	8	1	7	2	090	1	-	-
384	0900	6/9	09°34'S	139°52'W	82.6	080	10	82.0	77.0	1012	02	X	3	7	2	090	1	-	-
385	1100	6/9	09°34'S	139°49'W	82.5	070	14	82.1	76.0	1012	02	8	2	7	2	090	1	-	-
386	1300	6/9	09°34'S	139°48'W	82.5	090	13	81.4	75.3	1011	02	8	2	7	2	090	1	-	-
387	1500	6/9	09°34'S	139°48'W	82.5	070	14	81.5	75.4	1012	03	6,8	7	7	2	090	1	-	-
388	1700	6/9	09°34'S	139°49'W	82.7	070	12	81.4	75.8	1014	01	8,4	6	7	2	070	1	-	-
389	1900	6/9	09°34'S	139°50'W	82.8	100	17	80.6	76.7	1015	15	9,8	6	7	2	100	1	-	-
390	2100	6/9	09°34'S	139°50'W	83.0	090	09	83.8	76.8	1014	01	9,8	3	7	2	090	1	-	-

*Questionable

Table 5.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
391	2255	6/9	09°34'S	139°48'W	83.2	050	10	82.7	76.8	1012	02	8,4	3	7	2	070	1	-	-
392	0300	6/13	08°45'S	139°47'W	82.3	120	10	81.8	76.2	1011	02	6,8,9	2	7	2	070	1	-	-
393	0600	6/13	08°31'S	139°30'W	82.3	110	13	81.6	75.4	1012	01	8	1	7	3	090	1	-	-
394	0900	6/13	08°14'S	139°11'W	82.3	120	12	81.3	75.3	1013	02	8	1	7	2	120	1	-	-
395	1200	6/13	07°53'S	139°00'W	82.3	090	14	81.0	76.0	1012	02	8	1	7	2	120	1	-	-
396	1515	6/13	07°24'S	139°02'W	82.3	090	14	81.0	75.5	1012	03	8	3	7	1	120	1	-	-
397	1750	6/13	06°59'S	139°05'W	82.3	100	11	82.7	76.1	1014	02	1,8	3	7	1	100	1	-	-
398	2100	6/13	06°33'S	139°08'W	82.9	100	11	83.2	77.4	1013	03	8,9	4	8	1	100	1	-	-
399	0000	6/14	06°06'S	139°11'W	83.1	090	10	82.1	77.4	1011	15	4,8,9	6	6	1	100	1	-	-
400	0300	6/14	05°38'S	139°14'W	82.8	120	10	82.2	76.5	1011	15	6,2,9,8	3	6	1	120	1	-	-
401	0600	6/14	05°17'S	139°14'W	82.3	110	10	81.3	77.0	1013	01	X	1	7	1	120	1	-	-
402	0900	6/14	04°49'S	139°18'W	82.2	110	12	81.0	77.0	1013	01	X	1	7	1	120	1	-	-
403	1200	6/14	04°20'S	139°23'W	81.9	110	08	80.2	76.0	1011	00	8	1	7	1	120	1	-	-
404	1500	6/14	03°52'S	139°27'W	81.8	120	12	80.3	76.0	1011	00	8	2	7	1	130	1	-	-
405	1800	6/14	03°24'S	139°31'W	82.0	120	14	82.4	77.0	1013	03	8,1	2	6	1	120	1	-	-
406	2050	6/14	02°56'S	139°34'W	82.4	120	13	82.8	77.4	1012	02	8,4	2	6	1	120	1	-	-
407	0000	6/15	02°29'S	139°37'W	82.1	080	10	82.0	77.0	1010	01	8	6	7	1	110	1	-	-
408	0300	6/15	02°05'S	139°40'W	81.1	080	10	81.0	76.1	1010	01	8	3	7	1	110	1	-	-
409	0600	6/15	01°42'S	139°40'W	80.7	100	12	80.8	76.1	1012	00	X	X	7	1	110	1	-	-
410	0900	6/15	01°16'S	139°42'W	80.2	090	09	80.0	75.3	1012	00	8	1	7	1	130	1	-	-
411	1200	6/15	00°48'S	139°43'W	80.4	090	08	79.0	75.8	1010	02	8	1	6	1	100	2	-	-
412	1500	6/15	00°22'S	139°44'W	80.2	090	09	79.6	75.5	1010	03	8	2	6	1	100	2	-	-
413	1825	6/15	00°01'S	140°02'W	81.1	110	10	81.2	76.0	1012	02	8	2	7	0	080	0	-	-
414	1945	6/15	00°00'	140°03'W	81.3	120	09	82.0	77.2	1012	03	8	3	6	1	100	2	-	-
415	2100	6/15	00°08'N	140°10'W	81.8	100	09	82.2	76.3	1011	03	8	5	7	2	130	1	-	-
416	0000	6/16	00°29'N	140°30'W	83.0	120	08	82.0	76.0	1009	02	8	6	7	2	120	1	-	-
417	0300	6/16	00°49'N	140°50'W	83.1	100	12	81.8	75.6	1008	02	8	5	7	2	100	1	-	-
418	0600	6/16	01°06'N	141°04'W	82.9	110	12	81.9	76.2	1009	01	8	1	6	2	110	1	-	-
419	0900	6/16	01°29'N	141°22'W	82.8	100	10	81.8	75.7	1010	02	8	1	6	1	110	1	-	-
420	1200	6/16	01°52'N	141°40'W	82.8	100	11	81.6	75.5	1008	02	8	1	7	1	110	1	-	-
421	1500	6/16	02°15'N	141°59'W	82.7	110	07	81.5	75.2	1008	02	8	1	7	1	110	1	-	-
422	1800	6/16	02°36'N	142°11'W	82.8	120	11	82.4	75.0	1010	02	8	3	7	1	110	1	-	-
423	2055	6/16	03°00'N	142°23'W	82.9	120	11	82.9	76.0	1010	01	8	1	6	2	130	1	-	-
424	0000	6/17	03°24'N	142°35'W	83.4	120	10	83.2	75.8	1008	01	8	1	6	0	120	1	-	-
425	0300	6/17	03°46'N	142°48'W	83.2	120	10	82.8	76.0	1008	02	8,1	1	6	1	130	1	-	-

Table 5.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Baro-meter, mb.	Wea-ther	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
426	0600	6/17	04°02'N	142°58'W	83.0	130	12	82.1	76.2	1010	02	8	1	7	1	110	1	-	-
427	0900	6/17	04°23'N	143°10'W	83.1	130	12	81.8	76.2	1010	02	8	1	7	1	110	1	-	-
428	1200	6/17	04°45'N	143°23'W	83.2	130	13	82.0	75.5	1009	03	8	2	7	1	120	1	-	-
429	1500	6/17	05°06'N	143°36'W	83.3	090	16	82.5	76.5	1009	25	6	7	6	1	120	1	-	-
430	1800	6/17	05°27'N	143°48'W	82.9	090	12	78.0	76.5	1011	81	9,8,6	8	6	1	080	1	-	-
431	2100	6/17	05°48'N	144°02'W	83.0	220	07	78.8	76.7	1011	25	6,9,8	7	5	1	090	1	-	-
432	0000	6/18	06°07'N	144°12'W	83.0	290	03	80.2	77.0	1010	80	6,9,8	8	7	1	090	1	-	-
433	0300	6/18	06°28'N	144°25'W	84.0	110	06	80.3	77.1	1010	15	6,8	6	7	2	090	1	-	-
434	0600	6/18	06°48'N	144°40'W	83.5	120	11	81.7	77.0	1011	00	X	X	7	2	090	1	-	-
435	0855	6/18	07°00'N	144°48'W	83.1	110	12	80.8	77.0	1012	25	X	X	7	2	090	1	-	-
436	1200	6/18	07°19'N	145°03'W	83.2	090	15	81.6	77.5	1010	01	8	2	6	2	080	1	-	-
437	1500	6/18	07°37'N	145°19'W	82.9	100	10	81.7	76.8	1010	15	8,6	2	6	2	050	1	-	-
438	1800	6/18	07°57'N	145°37'W	82.8	080	09	82.8	77.8	1012	15	4,1,9,8	2	6	2	060	1	-	-
439	2100	6/18	08°16'N	145°54'W	83.0	060	09	83.0	77.7	1012	02	1,4,8	4	7	1	060	1	-	-
440	0000	6/19	08°35'N	146°10'W	83.2	060	09	82.9	77.1	1011	01	8	3	7	2	050	1	-	-
441	0300	6/19	08°53'N	146°26'W	83.0	050	11	82.5	77.0	1010	01	8	2	7	2	050	1	-	-
442	0600	6/19	09°13'N	146°43'W	82.7	040	14	81.6	76.8	1012	02	8	2	6	2	040	1	-	-
443	0900	6/19	09°31'N	146°55'W	82.4	040	14	81.3	75.4	1012	13	8,9	2	6	2	030	1	34.07	-
444	1200	6/19	09°53'N	147°14'W	82.0	030	14	80.1	76.0	1012	50	8	6	7	2	030	2	34.05	-
445	1500	6/19	10°16'N	147°34'W	81.5	030	16	80.1	77.0	1011	50	1,8,9	5	7	2	030	2	34.13	-
446	1800	6/19	10°38'N	147°54'W	82.0	050	16	80.6	77.6	1012	25	4,8,9	7	6	2	030	1	34.36	-
447	2100	6/19	11°00'N	148°13'W	82.0	040	18	81.4	78.0	1012	15	1,8,9	7	7	3	040	1	34.33	-
448	0000	6/20	11°21'N	148°30'W	82.0	050	21	81.4	77.8	1012	16	1,2,8,6,5	6	6	4	040	3	34.36	-
449	0300	6/20	11°40'N	148°47'W	81.1	060	20	81.3	77.6	1011	16	2,7,4	6	6	4	050	3	34.42	-
450	0600	6/20	12°02'N	149°03'W	80.5	050	22	80.0	77.0	1013	01	1,8	4	7	3	050	3	34.47	-
451	0900	6/20	12°18'N	149°14'W	79.3	050	22	78.5	76.1	1014	01	X	2	7	3	050	3	34.60	-
452	1200	6/20	12°38'N	149°32'W	79.2	050	16	77.7	76.0	1013	00	X	4	6	3	050	3	34.60	-
453	1500	6/20	12°58'N	149°50'W	79.6	050	22	78.0	75.6	1013	03	8	6	7	3	050	3	34.67	-
454	1800	6/20	13°18'N	150°05'W	79.7	060	21	78.3	75.3	1014	60	7	8	5	3	050	3	34.69	-
455	2100	6/20	13°38'N	150°22'W	79.4	060	21	78.0	74.3	1015	01	2,8,4	5	6	3	060	3	34.67	-
456	0000	6/20	13°59'N	150°39'W	79.1	050	22	78.3	74.0	1014	02	1,3,4,8	5	7	3	060	3	34.65	-
457	0300	6/21	14°20'N	150°54'W	79.0	050	20	78.2	73.2	1014	03	1,6,8	6	7	3	050	3	34.65	-
458	0600	6/21	14°41'N	151°10'W	78.0	070	20	77.9	72.5	1015	03	6,8	6	6	3	050	3	34.61	-
459	0900	6/21	14°58'N	151°22'W	77.9	080	20	77.2	72.0	1016	01	8	1	7	3	050	3	34.54	-
460	1210	6/21	15°20'N	151°38'W	77.8	070	18	77.1	72.0	1015	01	8	2	6	3	050	1	34.54	-

Table 5.--Observations at bathythermograph lowerings, Hugh M. Smith cruise 45 (coded according to H. O. Pub. 606-c, second edition, 1956) (cont'd)

Ser. No.	Time, GCT	Date, 1958	Latitude	Longitude	Bkt. temp., °F.	Wind		Air temp.		Barometer, mb.	Weather	Clouds		Visibility	Sea	Swell		Surf. sal., ‰	Surf. PO_4-P, µg at./L.
						Dir., °T.	Force, kt.	Dry bulb, °F.	Wet bulb, °F.			Type	Cover			Dir. °T.	Amt.		
461	1500	6/21	15°41'N	151°55'W	77.8	070	16	76.8	70.8	1015	03	8,4	3	6	3	050	1	34.63	-
462	1800	6/21	16°03'N	152°12'W	77.1	040	16	77.0	71.6	1017	20	0,6,8	7	5	2	050	1	34.61	-
463	2100	6/21	16°26'N	152°30'W	77.0	060	19	77.0	71.5	1016	01	4,6,8	3	7	3	050	3	34.60	-
464	0000	6/22	16°43'N	152°50'W	77.1	050	15	78.9	71.1	1015	02	6,8	2	6	3	030	2	34.69	-
465	0300	6/22	16°59'N	153°15'W	77.2	050	16	77.5	71.0	1015	03	6,8	3	7	3	050	2	-	-
466	0600	6/22	17°14'N	153°40'W	77.1	050	16	77.2	69.7	1015	01	8	2	6	2	050	1	-	-
467	0900	6/22	17°29'N	153°56'W	77.1	070	15	76.6	71.2	1016	02	8	2	6	2	010	1	-	-
468	1200	6/22	17°46'N	154°19'W	76.9	050	09	76.3	71.0	1015	50	0	4	6	2	050	1	-	-
469	1500	6/22	18°04'N	154°42'W	76.9	050	09	76.6	70.0	1015	02	1,6,8	3	7	2	050	1	-	-
470	1800	6/22	18°22'N	155°06'W	77.1	060	13	77.4	71.3	1016	01	6,8	1	7	2	040	1	-	-
471	2100	6/22	18°40'N	155°30'W	77.1	060	13	77.4	74.0	1016	03	6,8	2	7	2	040	1	-	-
472	0000	6/23	18°58'N	155°51'W	77.7	120	18	77.9	71.6	1015	03	6,8	3	7	2	090	1	-	-
473	0300	6/23	19°16'N	156°08'W	78.2	230	04	77.8	72.2	1013	15	4,6,8	5	7	1	280	1	-	-
474	0600	6/23	19°36'N	156°26'W	77.9	230	13	77.2	71.0	1014	03	4,6,8	7	6	1	280	1	-	-
475	0900	6/23	19°52'N	156°40'W	77.5	320	09	77.0	70.3	1015	01	4,8	2	8	1	XXX	1	-	-
476	1200	6/23	20°14'N	156°56'W	77.6	070	17	76.2	71.9	1014	00	8	3	8	1	060	1	-	-
477	1500	6/23	20°36'N	157°12'W	77.0	010	12	75.4	70.1	1014	03	8	5	8	1	060	1	-	-

Table 6.--Weather observations (USWB 1210-F), Charles H. Gilbert cruise 35[1]

Date, 1957	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
10/4	18.9°N	155.9°W	0000	99	11	10	03	1	1011.9	7	2.7	80.0	74.5	80.2	5	5	4	6	0	0	11	2	2
10/4	18.2°N	155.5°W	0600	97	08	13	00	1	1013.5	1	1.7	79.9	75.0	79.2	3	3	1	5	0	0	11	2	2
10/4	17.4°N	155.1°W	1200	99	08	14	00	0	1012.5	7	1.4	78.0	73.8	78.0	X	X	X	X	X	X	09	2	3
10/4	16.7°N	154.6°W	1800	98	08	15	02	0	1013.2	2	0.7	80.0	73.8	79.4	3	3	1	5	0	0	09	2	3
10/5	15.9°N	154.0°W	0000	99	07	10	02	0	1011.2	7	2.0	80.5	75.0	80.0	3	3	4	5	0	0	09	2	3
10/5	15.2°N	153.5°W	0600	97	06	13	02	0	1011.5	3	0.7	80.0	75.0	79.7	3	3	8	5	0	0	09	2	3
10/5	14.4°N	153.1°W	1200	99	08	15	02	0	1010.2	7	1.4	81.0	75.0	81.3	3	3	8	5	0	0	09	2	3
10/5	13.7°N	152.7°W	1800	98	08	14	03	1	1012.5	2	2.0	81.3	76.0	81.1	8	8	8	5	X	X	10	2	3
10/6	12.9°N	152.3°W	0000	98	05	04	03	2	1009.8	7	2.4	81.6	77.0	82.1	8	8	8	5	X	X	10	2	3
10/6	12.2°N	151.8°W	0600	97	08	06	16	6	1012.2	2	2.0	81.0	76.0	82.2	8	8	8	5	X	X	10	2	2
10/6	11.4°N	151.4°W	1200	97	10	10	16	2	1010.8	7	1.4	81.0	76.0	81.5	8	8	8	5	X	X	10	2	2
10/6	10.7°N	150.9°W	1800	97	09	09	14	2	1012.5	2	2.4	83.0	77.0	82.1	8	8	4	5	X	X	09	2	2
10/7	09.9°N	150.4°W	0000	97	09	07	02	2	1010.5	6	1.4	81.6	76.1	82.1	8	8	8	5	X	X	10	2	2
10/7	09.1°N	150.0°W	0600	97	09	14	02	2	1012.9	1	2.0	80.3	76.0	82.2	8	8	8	5	X	X	09	2	2
10/7	07.7°N	149.0°W	1800	97	15	13	02	2	1012.9	1	2.0	84.0	77.2	83.0	6	6	8	5	0	0	12	2	2
10/8	07.0°N	148.6°W	0000	99	12	12	02	1	1009.1	7	2.0	83.8	77.3	83.8	4	4	1	5	0	0	14	2	2
10/8	06.4°N	148.2°W	0600	99	13	08	02	1	1011.5	2	2.4	82.5	78.0	82.3	5	5	4	5	0	0	13	2	2
10/8	05.7°N	147.7°W	1200	97	11	10	01	1	1010.5	6	1.0	81.8	75.3	81.8	2	2	1	5	0	0	13	2	2
10/8	05.0°N	147.3°W	1800	99	13	14	02	0	1012.9	2	2.0	82.0	76.0	81.0	4	4	2	4	0	0	13	2	2
10/9	04.3°N	146.9°W	0000	99	15	11	02	1	1009.1	7	3.1	82.0	74.8	81.8	4	2	1	4	3	0	13	2	2
10/9	03.6°N	146.6°W	0600	99	13	10	02	1	1011.5	2	2.4	81.3	74.0	81.2	1	1	1	4	0	0	12	2	2
10/9	02.9°N	146.2°W	1200	97	15	11	02	0	1010.5	6	1.5	80.0	74.0	80.4	3	1	1	4	3	0	15	2	2
10/9	02.2°N	145.8°W	1800	99	15	09	02	0	1012.5	2	1.7	81.0	76.0	80.6	1	1	1	4	0	0	15	2	2
10/10	01.5°N	145.4°W	0000	99	15	19	03	1	1009.5	6	1.0	80.8	75.1	80.1	8	4	8	4	3	0	14	2	2
10/10	00.8°N	144.9°W	0600	99	12	10	01	1	1011.9	2	1.4	81.0	75.0	79.7	1	1	2	5	0	0	14	2	2
10/10	00.0°	144.4°W	1200	97	11	10	02	0	1010.2	6	0.9	79.3	75.8	79.1	3	3	1	5	0	0	14	2	2
10/10	00.7°S	144.0°W	1800	99	13	11	02	0	1011.9	2	1.4	81.0	76.3	79.7	3	4	1	4	0	0	14	2	2
10/11	01.5°S	143.6°W	0000	99	12	09	02	0	1008.8	6	1.0	80.0	75.0	80.0	2	3	1	4	0	0	13	2	2
10/11	02.4°S	143.3°W	0600	99	11	13	03	1	1011.5	1	2.0	81.2	75.3	79.9	8	8	4	4	X	X	12	2	2
10/11	03.2°S	143.1°W	1200	97	11	13	02	2	1011.5	5	0.7	79.7	75.1	79.3	5	5	2	4	0	0	13	2	2
10/11	04.0°S	142.8°W	1800	99	11	15	01	1	1013.5	1	0.3	81.2	75.3	79.9	0	0	0	9	0	0	11	2	2
10/12	04.8°S	142.5°W	0000	99	12	12	02	0	1009.1	7	2.0	80.6	75.3	80.4	0	0	0	9	0	0	12	2	2
10/12	05.6°S	142.2°W	0600	99	10	11	02	0	1011.5	2	2.0	81.0	75.3	80.3	0	0	0	9	0	0	12	2	2
10/12	06.2°S	141.8°W	1200	97	11	07	01	0	1011.2	6	0.7	80.0	73.0	80.5	1	1	1	4	0	0	12	2	2
10/12	06.9°S	141.4°W	1800	99	11	09	02	0	1014.2	1	1.5	81.2	74.3	81.0	1	1	1	4	0	0	11	2	2
10/13	07.6°S	141.0°W	0000	99	10	09	02	0	1011.5	6	1.7	81.2	74.7	82.0	1	1	1	4	0	0	11	2	2
10/13	08.3°S	140.6°W	0600	99	09	14	02	0	1013.2	1	1.7	82.5	75.5	81.7	1	1	1	4	0	0	11	2	2
10/15	08.2°S	140.8°W	0000	99	09	07	01	2	1011.5	7	1.7	82.2	75.3	82.3	4	4	2	4	0	0	08	2	2
10/18	09.8°S	138.9°W	0000	97	06	15	25	6	1010.5	6	0.9	82.3	78.2	82.0	8	8	2	4	X	X	06	2	2
10/19	10.4°S	138.8°W	0000	98	13	17	03	1	1010.8	7	1.4	82.0	75.0	82.3	6	6	0	8	1	0	12	2	3

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[1] All columns in USWB 1210-F are not included here. Those deleted are:

Column	2	Day of week	Column	23	Course of ship
"	3	Octant	"	24	Speed of ship
"	13	Barometer as read	"	31	Diff. sea-air, °F.
"	14	Barometer as corrected	"	32	Dew point, °F.
"	17	Air temperature, °F.			

Table 6.--Weather observations (USWB 1210-F), *Charles H. Gilbert* cruise 35 (cont'd)

Date, 1957	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
10/22	09.6°S	139.8°W	0000	97	05	12	25	8	1011.5	7	1.0	81.2	75.3	82.2	8	8	7	4	X	X	05	2	2
10/24	09.1°S	139.2°W	1800	99	09	16	02	1	1012.2	1	1.4	82.2	76.0	80.7	4	4	1	4	0	0	09	2	2
10/25	09.1°S	138.8°W	0000	99	09	13	02	1	1012.2	7	2.4	82.2	76.3	81.7	4	4	1	4	0	0	09	2	2
10/25	09.2°S	138.1°W	0600	97	07	09	02	0	1014.6	1	2.0	81.2	75.7	80.3	4	4	2	4	0	0	09	2	2
10/25	09.4°S	137.4°W	1300	97	09	10	01	8	1010.5	5	0.7	80.4	75.4	80.1	2	2	2	4	0	0	09	2	2
10/25	09.4°S	136.7°W	1800	99	09	12	02	1	1015.9	1	1.4	81.3	74.3	80.3	4	4	2	4	0	0	09	2	2
10/26	09.3°S	136.0°W	0000	99	09	09	02	0	1012.2	7	2.4	82.2	74.5	81.0	1	1	1	4	6	0	09	2	2
10/26	09.3°S	136.1°W	0600	97	09	12	02	0	1014.6	1	2.0	81.7	74.7	80.6	2	2	1	4	0	0	09	2	2
10/26	09.2°S	136.5°W	1300	97	06	12	03	8	1012.5	5	0.7	80.4	73.9	80.4	4	4	2	4	0	0	09	2	2
10/26	09.2°S	137.3°W	1800	99	09	09	02	2	1014.9	1	1.4	83.0	75.0	81.3	6	6	2	5	0	0	09	2	2
10/27	09.3°S	138.0°W	0000	99	08	10	02	2	1011.9	6	1.7	83.0	76.0	82.0	7	7	2	5	0	0	09	2	2
10/27	09.3°S	138.8°W	0600	97	10	12	02	1	1013.9	1	1.7	81.1	74.1	81.1	2	2	2	4	0	0	09	2	2
10/27	09.3°S	139.2°W	1300	97	09	10	02	8	1012.5	5	0.2	81.1	75.9	81.4	2	2	2	4	0	0	09	2	2
10/27	09.6°S	139.6°W	1800	99	07	15	03	1	1014.9	2	1.7	81.8	75.2	81.8	6	6	4	4	0	0	08	2	2
10/28	10.2°S	139.6°W	0000	99	09	16	03	2	1011.9	7	1.7	82.0	76.3	82.0	4	4	2	4	0	0	09	2	2
10/28	10.8°S	139.6°W	0600	97	09	15	02	1	1014.6	1	1.7	81.3	76.0	81.7	3	3	2	4	0	0	09	2	2
10/28	11.4°S	139.4°W	1300	96	09	05	25	8	1013.5	3	0.7	78.2	74.9	82.0	7	7	2	4	0	0	09	2	2
10/28	12.0°S	139.5°W	1800	99	07	16	01	1	1015.6	1	1.7	82.2	76.0	81.8	4	4	2	4	0	0	08	2	2
10/29	12.6°S	139.6°W	0000	99	09	15	01	1	1012.9	6	1.4	82.5	75.5	81.5	4	4	2	4	0	0	09	2	2
10/29	12.6°S	139.6°W	0600	96	08	14	02	0	1014.6	2	1.4	81.8	75.8	81.1	4	4	2	4	0	0	09	2	2
10/29	12.2°S	139.4°W	1300	96	08	18	02	1	1013.5	6	0.7	80.2	75.5	81.5	4	4	2	4	0	0	09	2	2
10/29	11.6°S	139.4°W	1800	97	12	14	14	8	1015.2	1	1.7	80.0	76.5	82.0	6	6	2	4	0	0	10	2	2
10/30	11.0°S	139.5°W	0000	98	07	18	03	1	1011.5	7	1.4	81.0	74.5	81.8	7	7	4	4	0	0	09	2	2
10/30	10.2°S	138.7°W	0600	97	08	17	02	2	1013.2	2	1.4	81.5	75.2	81.5	5	5	4	4	0	0	09	2	2
10/30	09.6°S	139.7°W	1300	97	08	17	01	1	1011.2	6	1.4	81.1	74.0	81.3	1	1	2	4	0	0	09	2	2
11/1	08.9°S	139.6°W	1800	99	08	20	02	0	1013.9	0	0.0	83.5	76.0	81.0	2	2	2	4	0	0	08	2	2
11/2	08.1°S	139.6°W	0000	99	08	16	03	1	1009.8	7	1.7	82.0	76.3	81.3	6	6	6	4	0	0	08	2	2
11/2	07.5°S	139.6°W	0600	97	08	16	02	1	1011.9	2	1.4	80.7	75.9	80.5	4	4	1	4	0	0	08	2	2
11/2	07.1°S	139.5°W	1300	96	10	16	02	2	1010.2	5	0.3	80.0	74.5	79.7	4	4	2	4	0	0	08	2	2
11/2	06.5°S	139.5°W	1800	98	08	18	02	1	1012.2	1	1.7	80.8	75.5	80.0	4	4	2	4	0	0	08	2	2
11/3	05.9°S	139.7°W	0000	98	08	12	02	1	1007.8	7	2.4	80.8	75.0	80.9	2	2	2	4	6	0	08	2	2
11/3	05.8°S	139.8°W	0600	96	10	15	02	0	1010.5	2	2.4	80.3	74.8	79.7	4	4	1	4	0	0	08	2	2
11/3	06.5°S	139.8°W	1300	96	11	10	01	0	1009.1	3	0.3	79.9	74.7	79.9	1	1	1	4	0	0	08	2	2
11/3	07.0°S	139.9°W	1800	96	08	14	02	0	1012.5	1	1.4	82.0	76.2	80.8	2	2	4	4	0	0	08	2	2
11/4	07.6°S	139.6°W	0100	98	08	10	15	1	1008.8	5	0.7	81.2	76.2	81.0	7	7	4	4	0	0	08	2	2
11/4	08.4°S	139.5°W	0600	97	10	17	01	1	1011.9	2	2.0	81.5	75.1	80.9	1	1	1	4	0	0	10	2	2
11/4	08.9°S	139.7°W	1300	97	09	09	02	0	1011.2	5	0.0	80.5	74.0	81.3	2	2	1	4	0	0	10	2	2
11/4	09.2°S	140.0°W	1800	99	09	14	02	0	1013.5	1	0.7	84.0	75.0	81.8	2	2	2	4	0	0	09	2	2
11/5	09.2°S	140.6°W	0000	99	09	10	02	0	1008.5	7	2.0	84.0	75.0	82.0	1	1	2	4	0	0	09	2	2
11/5	09.2°S	141.3°W	0600	97	11	15	02	0	1011.2	1	1.5	81.3	76.0	82.0	2	2	1	4	0	0	09	2	2
11/5	09.2°S	142.0°W	1300	97	09	15	03	1	1010.2	5	0.0	81.3	75.0	80.3	4	4	2	4	0	0	09	2	2
11/5	09.2°S	142.3°W	0900	99	09	15	01	0	1012.5	2	1.7	85.0	76.2	82.5	1	1	2	4	0	0	09	2	2
11/6	09.2°S	143.4°W	0000	99	09	09	02	0	1008.8	7	2.0	85.0	76.0	83.1	3	3	1	4	0	0	09	2	2
11/6	09.2°S	143.0°W	0600	97	11	14	02	0	1010.8	2	1.0	82.5	76.0	82.0	4	4	1	4	0	0	09	2	2
11/6	09.3°S	142.3°W	1300	97	09	12	02	0	1009.5	5	0.0	81.8	75.0	82.0	4	4	1	4	0	0	09	2	2
11/6	09.3°S	141.8°W	1800	99	08	18	01	0	1012.2	2	2.4	82.5	75.0	81.6	1	1	2	4	0	0	09	2	2
11/7	09.3°S	141.3°W	0000	99	08	09	02	0	1008.8	7	2.0	83.8	74.2	81.4	1	1	2	4	0	0	09	2	2
11/7	09.3°S	140.7°W	0600	97	09	12	02	0	1010.8	1	1.4	81.4	74.1	81.5	1	1	8	4	0	0	09	2	2
11/7	09.3°S	140.1°W	1300	97	11	14	03	1	1009.1	6	1.2	80.8	74.0	80.8	4	4	4	4	0	0	09	2	2
11/8	09.4°S	140.7°W	1800	99	11	16	02	1	1011.5	1	1.4	83.0	76.0	81.7	4	4	2	4	0	0	11	2	2

Table 6.--Weather observations (USWB 1210-F), *Charles H. Gilbert* cruise 35 (cont'd)

					Wind		Weather		Pressure			Temperature			Clouds						Waves		
Date, 1957	Latitude	Longitude	Time, GCT	Visibility	Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
11/9	10.0°S	141.3°W	0000	99	11	16	01	0	1007.8	7	1.4	82.8	75.5	82.4	2	2	1	4	0	0	15	2	2
11/9	10.8°S	141.9°W	0600	99	11	16	01	0	1009.5	2	1.4	83.0	76.5	81.4	2	2	1	4	0	0	13	2	2
11/9	11.5°S	142.4°W	1200	97	11	18	02	0	1009.1	7	0.9	81.5	75.5	82.0	2	2	1	4	0	0	14	2	2
11/9	12.1°S	143.0°W	1800	99	08	11	02	0	1012.2	2	1.4	83.0	77.2	82.6	4	4	1	4	0	0	13	2	2
11/10	12.7°S	143.8°W	0000	99	07	11	01	0	1009.1	6	1.4	84.8	77.0	83.7	2	2	1	4	0	0	12	2	2
11/10	13.3°S	144.5°W	0600	99	07	09	00	0	1010.5	2	0.7	84.8	76.6	82.6	9	X	X	X	X	X	10	2	2
11/10	13.8°S	145.0°W	1200	97	08	07	02	0	1009.5	7	1.0	81.9	75.8	82.3	2	2	1	4	0	0	10	2	2
11/10	14.3°S	145.9°W	1800	98	00	00	15	1	1012.2	2	2.0	82.2	76.0	82.8	6	6	2	4	0	0	09	2	2
11/11	14.6°S	146.3°W	1800	99	14	07	02	0	1012.5	1	1.4	83.4	77.0	83.4	2	2	4	4	0	0	00	0	0
11/12	14.9°S	147.2°W	0000	99	13	13	16	1	1010.5	6	1.4	83.5	75.0	84.0	4	4	2	4	0	0	13	2	2
11/12	14.9°S	148.0°W	1800	99	08	14	02	2	1013.2	2	1.0	83.8	77.0	83.7	4	4	2	4	0	0	10	2	2
11/13	15.0°S	148.0°W	0000	99	15	16	02	1	1010.8	7	1.7	82.5	76.2	83.0	2	2	2	4	0	0	15	2	2
11/13	15.2°S	148.0°W	1800	99	14	15	25	8	1012.5	1	1.4	81.9	75.3	82.5	4	4	2	4	0	0	15	2	2
11/14	15.9°S	148.3°W	0000	98	12	12	15	2	1010.2	6	1.4	82.0	74.0	82.0	7	7	8	4	0	0	15	2	2
11/14	16.5°S	148.7°W	0600	98	11	14	00	0	1012.5	2	1.4	80.0	72.5	80.5	X	X	X	X	X	X	11	2	2
11/14	17.0°S	149.1°W	1200	98	13	15	01	0	1009.8	7	2.0	79.5	72.8	79.3	2	2	1	4	0	0	12	2	2
11/19	17.4°S	149.4°W	0000	98	04	08	15	8	1010.5	6	1.4	81.4	77.0	81.1	6	6	2	4	0	0	07	2	2
11/19	16.8°S	148.8°W	0600	98	02	08	00	X	1011.9	2	1.7	83.0	78.0	81.2	9	X	X	X	X	X	07	2	2
11/19	16.3°S	148.2°W	1200	96	04	08	00	8	1010.5	6	1.4	81.1	76.5	81.3	5	5	X	X	X	X	07	2	2
11/19	15.8°S	147.6°W	1800	99	05	08	01	1	1012.2	1	1.4	83.0	77.0	82.0	3	3	2	4	0	0	08	2	2
11/20	15.3°S	147.0°W	0000	99	05	10	02	1	1009.1	7	1.4	83.2	76.9	83.1	5	3	2	4	0	1	05	2	2
11/20	15.0°S	146.4°W	0600	97	05	08	16	1	1010.5	2	1.7	80.0	76.2	82.5	5	5	X	X	X	X	07	2	2
11/20	14.6°S	145.7°W	1200	94	04	04	00	8	1009.1	7	1.4	81.1	75.1	82.9	6	6	X	X	X	X	07	2	2
11/20	14.1°S	145.1°W	1800	97	06	13	16	8	1011.5	2	1.4	79.0	75.0	82.3	7	7	2	4	2	0	07	2	2
11/21	13.5°S	144.5°W	0000	98	35	06	02	2	1009.1	7	1.4	82.2	76.8	84.0	7	2	1	4	1	0	00	2	2
11/21	12.9°S	143.9°W	0600	98	04	09	01	1	1011.5	2	2.0	83.0	76.0	82.6	0	0	0	9	0	0	00	2	2
11/21	12.4°S	143.4°W	1200	94	04	12	01	0	1010.2	6	1.4	82.3	75.1	82.9	2	2	1	4	0	0	00	2	2
11/21	11.8°S	142.8°W	1800	99	03	13	02	0	1012.5	2	1.7	83.2	76.5	82.0	2	2	1	4	0	0	04	2	2
11/22	11.2°S	142.2°W	0000	99	03	09	02	0	1009.8	6	2.0	83.5	75.6	83.1	3	2	1	4	1	0	04	2	2
11/22	10.6°S	141.7°W	0600	99	08	12	02	0	1012.5	2	2.0	83.0	76.3	82.3	3	3	X	X	X	X	06	2	2
11/22	10.1°S	141.1°W	1200	94	08	11	02	0	1011.2	6	1.5	81.9	76.0	82.5	3	3	X	X	X	X	05	2	2
11/22	09.5°S	140.6°W	1800	99	07	13	15	0	1012.9	1	1.4	81.0	76.2	82.0	3	3	4	4	0	0	05	2	2
11/26	08.0°S	139.7°W	0000	99	06	14	02	0	1009.1	7	1.7	81.9	75.4	81.9	3	3	1	4	0	0	06	2	2
11/27	09.0°S	139.5°W	0000	99	07	17	02	0	1009.1	7	2.0	82.5	76.0	82.1	3	3	2	4	0	0	07	2	2
11/29	10.1°S	139.1°W	0000	99	10	09	03	1	1009.8	7	1.4	84.0	76.8	82.8	6	6	2	4	0	0	12	2	2
12/1	09.4°S	139.9°W	0000	99	05	10	02	0	1007.8	7	2.4	82.9	76.2	83.1	2	2	2	4	0	0	06	2	2
12/1	09.5°S	139.8°W	1800	99	06	07	02	0	1011.2	2	1.4	82.9	75.1	81.5	2	2	2	4	0	0	06	2	2
12/2	09.6°S	139.8°W	0000	99	04	07	02	0	1008.5	7	1.4	83.5	76.2	83.5	2	2	2	4	0	0	08	2	2
12/2	09.6°S	139.8°W	0600	99	07	09	03	0	1011.9	2	2.7	81.1	75.7	82.0	4	4	4	4	0	0	08	2	2
12/2	09.6°S	139.9°W	1200	99	03	12	01	0	1010.2	6	1.4	81.0	75.9	81.8	2	2	4	4	0	0	08	2	2
12/4	07.9°S	140.7°W	1800	99	09	18	03	0	1013.5	2	1.7	82.5	76.0	82.0	4	4	2	4	4	0	09	2	2
12/5	07.1°S	141.1°W	0000	99	05	13	02	2	1010.5	7	1.4	83.0	76.0	82.2	7	7	4	4	0	0	05	2	2
12/5	06.4°S	141.6°W	0600	99	06	13	01	1	1013.2	2	2.4	82.0	76.0	81.8	2	2	1	4	0	0	06	2	2
12/5	05.7°S	142.1°W	1200	97	05	17	03	1	1011.2	7	1.4	81.1	76.2	81.3	5	5	2	4	0	0	06	2	2
12/5	04.9°S	142.5°W	1800	99	09	19	02	1	1013.5	1	1.4	82.2	76.6	81.5	4	4	2	4	3	0	06	2	2
12/6	04.2°S	143.0°W	0000	99	08	13	02	1	1010.5	7	2.4	82.5	76.5	82.3	5	5	4	4	0	0	07	2	2
12/6	03.5°S	143.4°W	0600	99	06	15	01	1	1012.5	2	2.4	82.2	76.5	81.9	2	2	2	4	0	0	07	2	2
12/6	02.6°S	143.6°W	1200	97	07	13	02	1	1011.9	7	2.0	81.8	76.0	81.8	4	4	1	4	0	0	07	2	2
12/6	01.8°S	143.9°W	1800	99	08	16	02	1	1013.5	2	1.0	83.0	77.0	82.1	4	4	1	4	0	0	09	2	2
12/7	01.0°S	144.2°W	0000	99	09	16	02	1	1010.8	7	2.0	83.2	77.0	83.0	7	6	2	4	1	0	09	2	2

Table 6.--Weather observations (USWB 1210-F), Charles H. Gilbert cruise 35 (cont'd)

Date, 1957	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
12/7	00.3°S	144.6°W	0600	97	13	07	21	6	1013.9	2	2.7	78.0	77.0	81.8	8	8	4	4	X	X	13	2	2
12/7	00.5°N	145.0°W	1200	97	13	14	01	8	1012.5	7	2.0	81.9	76.1	81.9	4	4	2	4	0	0	13	2	2
12/7	01.1°N	145.4°W	1800	98	14	14	03	1	1014.2	2	1.4	83.2	76.0	82.3	6	6	2	4	3	0	14	2	2
12/8	01.9°N	145.9°W	0000	99	12	13	02	2	1010.8	7	2.0	82.9	77.0	83.1	4	4	2	4	0	0	13	2	2
12/8	02.6°N	146.4°W	0600	99	13	09	02	2	1013.5	2	2.0	83.0	77.5	82.0	6	6	2	4	1	0	13	2	2
12/8	03.3°N	146.9°W	1200	97	11	10	15	8	1011.5	7	2.0	81.5	76.8	82.5	5	5	2	4	0	0	13	2	2
12/8	04.1°N	147.4°W	1800	97	12	10	52	8	1013.9	1	2.0	78.8	76.3	82.0	8	8	2	4	2	X	13	2	2
12/9	04.8°N	147.8°W	0000	98	09	05	03	2	1009.8	7	3.1	82.1	77.9	82.9	8	8	4	4	X	X	11	2	2
12/9	05.6°N	148.2°W	0600	99	07	07	01	2	1011.5	2	1.7	82.0	77.2	82.2	6	6	4	4	0	0	11	2	2
12/9	06.4°N	148.6°W	1200	97	05	07	02	1	1010.2	8	1.4	81.5	75.5	83.5	4	4	1	4	0	0	06	2	2
12/9	07.1°N	148.9°W	1800	99	06	06	02	0	1011.5	2	1.7	83.5	76.0	82.8	4	4	2	4	6	1	06	2	2
12/10	07.9°N	149.4°W	0000	98	06	12	16	2	1008.8	7	1.7	80.5	77.1	83.5	8	7	2	4	2	X	02	2	2
12/10	08.6°N	149.9°W	0600	98	06	16	00	X	1011.2	2	1.7	81.0	76.5	82.1	X	X	X	X	X	X	06	2	2
12/10	09.4°N	150.3°W	1200	96	06	13	02	1	1010.5	7	1.0	81.0	76.4	82.0	5	4	2	4	1	0	05	2	2
12/10	10.2°N	150.8°W	1800	98	07	15	03	2	1013.2	2	2.0	81.2	76.5	80.5	8	8	1	4	4	X	02	3	4
12/11	11.0°N	151.3°W	0000	99	08	16	02	2	1009.8	7	2.0	81.1	77.3	80.9	7	5	2	4	3	0	03	3	4
12/11	11.7°N	151.8°W	0600	99	08	17	00	X	1012.2	2	2.0	81.5	76.0	80.0	4	4	X	X	X	X	05	3	4
12/11	12.4°N	152.4°W	1200	97	06	19	02	2	1011.2	8	1.4	80.1	76.1	80.1	7	3	2	4	5	0	04	3	3
12/11	13.1°N	153.0°W	1800	99	06	18	02	2	1012.5	2	1.7	80.0	76.0	79.8	6	6	1	4	5	0	05	3	3
12/12	13.8°N	153.5°W	0000	98	05	17	03	2	1011.2	7	1.9	80.1	76.0	80.1	8	5	2	4	2	X	05	3	3
12/12	14.6°N	153.9°W	0600	98	06	22	00	X	1013.5	2	2.0	79.0	74.0	79.2	9	X	X	X	X	X	05	3	3
12/12	15.3°N	154.4°W	1200	94	04	24	03	2	1012.9	7	1.2	77.0	73.0	77.9	8	8	2	4	X	X	05	3	3
12/12	16.1°N	154.8°W	1800	97	04	28	03	2	1013.9	2	1.7	77.0	74.0	77.8	8	8	2	4	X	X	05	3	5
12/13	16.8°N	155.3°W	0000	96	05	22	02	2	1012.5	7	1.0	76.5	69.1	77.8	8	8	4	4	X	X	05	3	5
12/13	17.5°N	155.6°W	0600	98	05	22	00	2	1013.9	2	1.4	75.5	69.0	77.3	8	X	X	X	X	X	05	3	5
12/13	18.3°N	156.0°W	1200	96	05	22	00	2	1013.2	7	1.4	74.1	68.0	76.1	6	4	1	4	5	0	04	3	5
12/13	19.1°N	156.2°W	1800	98	10	07	01	1	1014.2	1	1.7	75.5	68.5	76.9	1	1	2	4	0	0	11	2	2

Table 7.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 43[1]

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
1/4	21.6°N	158.6°W	0600	98	01	25	03	2	1018.3	1	1.4	68.2	63.0	74.0	X	X	X	X	X	X	32	3	8
1/4	21.6°N	158.4°W	1200	97	31	26	02	2	1016.6	7	0.7	68.1	60.2	73.0	X	X	X	X	X	X	32	3	8
1/4	22.3°N	157.9°W	1800	98	36	23	03	2	1018.3	2	2.0	68.4	59.2	72.2	6	2	7	4	6	0	32	3	8
1/5	21.8°N	157.9°W	0000	98	34	21	01	1	1016.6	6	2.7	69.3	60.0	73.0	2	1	8	4	6	0	34	3	3
1/5	21.1°N	157.5°W	0600	97	35	26	03	1	1017.3	3	0.7	70.2	62.9	73.5	X	X	X	X	X	X	34	3	3
1/5	20.5°N	157.0°W	1200	98	02	22	00	1	1018.0	5	0.7	70.3	62.7	74.2	6	5	1	5	6	0	34	3	4
1/5	19.5°N	156.6°W	1800	98	03	20	01	1	1018.0	2	1.4	72.0	65.0	74.8	3	1	7	4	6	0	34	3	4
1/6	18.8°N	156.2°W	0000	99	36	07	02	1	1015.9	6	3.1	73.8	66.4	76.4	3	2	1	5	3	0	34	3	2
1/6	18.1°N	155.7°W	0600	97	06	19	03	1	1016.6	2	1.7	72.9	65.4	75.5	7	X	X	X	X	X	02	3	3
1/6	17.3°N	155.2°W	1200	98	03	21	80	1	1017.6	7	1.4	73.7	65.7	75.9	4	2	1	5	3	0	35	X	3
1/6	16.5°N	154.8°W	1800	98	05	15	01	5	1018.0	2	1.7	71.2	67.5	76.0	7	3	8	5	6	0	05	3	4
1/7	15.8°N	154.4°W	0000	98	07	15	01	1	1016.3	7	2.7	74.6	68.6	76.2	4	4	1	6	0	0	02	3	3
1/7	15.1°N	153.9°W	0600	98	06	19	01	0	1017.3	2	1.4	75.5	68.7	77.1	2	X	X	X	X	X	04	3	3
1/7	14.3°N	153.5°W	1200	98	06	16	15	1	1016.3	7	1.7	75.8	70.6	76.9	5	4	1	5	6	0	03	X	3
1/7	13.6°N	153.0°W	1800	98	04	17	01	1	1016.3	2	1.7	76.3	71.8	77.3	2	2	4	5	0	0	04	2	5
1/8	12.9°N	152.5°W	0000	98	07	17	03	0	1013.2	7	3.1	77.4	72.2	78.5	3	3	4	5	0	0	03	2	4
1/8	12.7°N	152.2°W	0600	97	06	18	01	2	1013.9	2	1.7	78.2	73.8	78.6	9	X	X	X	X	X	06	3	4
1/8	11.6°N	151.9°W	1200	98	08	16	01	1	1013.2	6	1.4	78.2	74.0	78.3	2	2	1	5	0	0	05	3	3
1/8	11.0°N	151.6°W	1800	98	07	18	01	0	1014.2	2	1.7	79.0	74.0	78.5	2	1	8	5	6	0	07	3	3
1/9	10.1°N	151.2°W	0000	98	07	18	02	0	1010.5	7	3.7	79.7	73.8	79.3	2	2	1	6	0	0	06	3	3
1/9	09.5°N	150.8°W	0600	98	07	19	01	0	1012.2	2	0.7	80.3	75.1	80.5	2	X	X	X	X	X	07	3	4
1/9	08.8°N	150.3°W	1200	97	08	19	03	1	1010.8	7	2.0	79.5	74.0	79.2	4	4	4	5	0	0	07	3	4
1/9	08.1°N	150.0°W	1800	98	07	24	01	0	1012.5	2	1.7	81.0	74.0	81.4	3	3	8	5	0	0	07	3	5
1/10	07.5°N	149.4°W	0000	98	06	18	03	1	1009.8	7	2.7	81.6	75.7	82.3	7	4	8	6	6	8	07	3	5
1/10	06.7°N	149.0°W	0600	98	04	19	03	1	1011.2	2	1.0	81.8	76.8	81.7	7	X	X	X	X	X	07	3	4
1/10	06.1°N	148.6°W	1200	97	03	20	25	2	1010.2	6	2.0	78.3	77.3	82.8	9	X	X	X	X	X	07	3	3
1/10	05.5°N	149.2°W	1800	95	08	19	63	6	1012.9	1	2.0	77.2	75.5	82.3	8	8	7	4	0	0	07	3	3
1/11	04.8°N	147.0°W	0000	95	07	28	60	5	1010.2	7	1.7	79.0	77.0	82.5	8	8	7	4	0	0	07	3	4
1/11	04.0°N	147.3°W	0600	96	10	18	02	2	1011.2	1	1.4	83.1	77.0	82.4	8	X	X	X	X	X	11	3	3
1/11	03.6°N	146.9°W	1200	96	12	17	02	2	1009.8	7	1.7	82.1	76.2	82.4	9	X	X	X	X	X	49	X	X
1/11	02.8°N	146.6°W	1800	97	13	17	00	2	1012.2	1	2.4	82.4	77.3	82.3	8	8	5	5	0	0	11	3	3
1/12	02.0°N	146.2°W	0000	97	12	15	02	2	1008.8	7	3.1	82.7	76.0	82.6	7	6	7	5	6	2	11	3	3
1/12	01.3°N	145.9°W	0600	97	11	19	01	1	1011.2	1	2.4	81.8	77.0	82.0	2	X	X	X	X	X	12	3	3
1/12	00.6°N	145.6°W	1200	97	11	18	01	0	1009.8	7	2.0	81.0	75.5	81.6	9	X	X	X	X	X	49	X	X
1/12	00.0°	145.3°W	1800	98	10	14	03	1	1011.5	1	2.4	82.4	76.3	81.9	5	2	1	4	0	6	09	3	3
1/13	00.9°S	144.9°W	0000	98	11	17	02	1	1008.1	7	3.1	82.5	75.7	82.2	2	1	8	5	0	6	09	3	3
1/13	01.6°S	144.5°W	0600	97	11	11	01	0	1010.5	2	2.0	81.7	75.8	82.2	2	X	X	X	X	X	11	3	3
1/13	02.3°S	144.1°W	1200	97	11	11	02	0	1009.5	7	1.0	81.2	76.0	82.2	9	X	X	X	X	X	11	3	3
1/13	03.0°S	143.7°W	1800	98	13	14	02	0	1011.5	2	1.7	82.6	76.6	82.2	3	2	1	4	0	6	10	3	3
1/14	03.8°S	143.3°W	0000	98	09	12	02	0	1008.8	7	2.4	82.5	76.5	83.1	2	2	4	4	0	0	10	3	3

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[1] All columns in USWB 1210-F are not included here. Those deleted are:

Column	2	Day of week	Column 23	Course of ship
"	3	Octant	" 24	Speed of ship
"	13	Barometer as read	" 31	Diff. sea-air, °F.
"	14	Barometer as corrected	" 32	Dew point, °F.
"	17	Air temperature, °F.		

Table 7.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 43 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
1/14	04.5°S	142.8°W	0600	98	09	11	02	0	1010.5	2	2.0	82.1	76.5	82.8	2	X	X	X	X	X	11	3	3
1/14	05.4°S	142.3°W	1200	98	11	08	00	0	1009.5	7	2.0	81.5	76.2	82.4	9	X	X	X	X	X	11	3	3
1/14	06.1°S	141.9°W	1800	98	07	11	02	1	1012.2	1	2.0	83.5	77.4	82.7	2	2	1	4	0	0	11	3	2
1/15	06.9°S	141.4°W	0000	98	07	11	02	0	1008.8	7	2.4	82.8	76.8	83.4	2	2	4	4	0	0	11	3	2
1/15	07.8°S	141.0°W	0600	98	07	11	02	0	1011.5	2	2.2	82.8	76.8	82.8	2	X	X	X	X	X	10	3	2
1/15	08.6°S	140.5°W	1200	98	07	11	00	0	1009.5	7	2.0	82.0	76.2	82.8	9	X	X	X	X	X	49	X	X
1/18	08.9°S	140.5°W	1800	98	05	18	02	2	1008.8	2	1.4	85.0	77.2	84.0	6	5	2	4	0	6	06	3	3
1/19	08.1°S	140.8°W	0000	98	06	16	01	2	1004.7	7	2.7	86.0	78.5	83.8	5	4	2	4	0	6	06	3	3
1/19	07.7°S	140.4°W	1800	98	06	20	25	1	1008.1	1	1.4	82.5	76.4	82.5	3	3	8	4	0	0	07	3	4
1/20	07.9°S	139.8°W	0000	98	05	14	03	1	1005.4	7	2.0	83.1	76.5	83.2	5	4	1	5	0	8	07	3	4
1/20	08.2°S	139.5°W	1800	98	04	16	01	2	1008.8	1	2.4	82.2	75.8	82.8	7	5	1	4	0	8	07	3	4
1/21	08.9°S	139.2°W	0000	98	06	10	01	2	1006.1	7	1.7	85.5	76.3	83.8	4	3	1	4	0	8	07	3	3
1/21	09.3°S	139.1°W	1800	98	06	16	03	1	1010.8	1	1.4	83.6	78.2	83.0	6	2	2	4	3	0	09	3	4
1/22	09.9°S	138.9°W	0000	98	09	11	15	2	1009.5	7	1.4	82.8	77.7	83.7	7	7	8	4	0	0	08	3	4
1/22	09.9°S	139.0°W	1800	98	06	11	01	1	1012.2	1	1.7	82.8	75.2	83.0	4	3	8	4	0	8	08	3	3
1/23	10.3°S	138.4°W	0000	98	03	14	03	1	1010.5	7	2.0	82.5	74.2	82.4	7	6	4	4	0	8	08	3	3
1/23	10.3°S	138.9°W	1800	99	02	13	02	2	1014.2	1	1.0	83.8	76.8	83.5	5	2	8	4	7	8	08	3	2
1/24	09.5°S	139.8°W	0000	98	05	08	03	2	1011.9	7	1.7	85.8	78.3	84.5	7	1	2	5	2	0	08	3	2
1/24	09.5°S	139.8°W	0600	98	06	08	02	2	1013.2	2	1.7	83.6	76.7	83.5	X	X	X	X	X	X	08	3	2
1/24	09.6°S	139.9°W	1200	98	07	10	02	2	1012.2	7	2.0	84.0	77.8	84.5	X	X	X	X	X	X	08	3	2
1/24	09.6°S	139.9°W	1800	98	04	11	15	2	1013.5	1	1.0	84.2	77.7	83.3	7	4	8	4	0	8	08	3	2
1/25	09.5°S	139.8°W	0000	98	07	08	02	1	1009.8	7	2.4	86.8	78.5	84.8	3	2	4	4	6	0	49	X	0
1/27	08.9°S	139.9°W	1800	98	01	06	60	6	1012.9	0	1.7	79.0	74.8	81.8	7	7	4	4	0	0	02	2	2
1/28	08.9°S	139.8°W	0000	99	07	09	15	6	1009.1	7	2.4	83.4	77.2	83.8	7	3	8	4	6	1	09	3	3
1/28	09.2°S	139.3°W	0600	97	09	14	00	2	1011.5	2	1.4	84.0	76.9	83.8	9	X	X	X	X	X	09	3	3
1/28	09.2°S	138.8°W	1200	97	09	15	00	2	1009.5	7	1.7	82.8	76.2	83.3	9	X	X	X	X	X	09	3	3
1/28	09.2°S	138.1°W	1800	97	06	17	02	2	1012.2	2	1.7	83.0	77.0	83.0	7	4	4	4	6	0	08	3	3
1/29	09.3°S	137.4°W	0000	97	08	10	15	2	1009.5	7	1.4	83.4	76.7	83.2	7	3	2	4	5	9	09	3	3
1/29	09.2°S	136.9°W	0600	97	08	14	00	2	1010.8	2	1.7	82.5	77.3	83.0	9	X	X	X	X	X	08	3	3
1/29	09.2°S	136.3°W	1200	97	08	10	00	2	1009.8	7	1.7	81.0	76.5	82.7	9	X	X	X	X	X	08	3	3
1/29	09.0°S	136.5°W	1800	97	01	11	02	2	1011.2	2	1.7	82.0	77.3	82.8	7	5	4	4	6	0	08	3	2
1/29	09.2°S	137.0°W	2300	94	10	36	61	1	1011.5	7	0.7	75.8	75.6	83.1	8	8	7	3	X	X	09	X	4
1/30	09.2°S	137.1°W	0000	95	11	27	61	6	1010.8	7	1.0	77.6	74.7	82.8	8	8	7	3	X	X	09	X	5
1/30	09.2°S	137.2°W	0100	96	10	31	21	6	1010.5	6	1.4	80.0	73.5	82.8	8	8	7	3	X	X	10	2	5
1/30	09.2°S	137.3°W	0200	96	10	26	01	2	1010.5	5	0.3	80.7	75.0	82.3	8	4	7	3	7	X	08	2	6
1/30	09.2°S	137.4°W	0300	97	11	32	01	2	1011.2	3	1.4	81.0	75.3	82.2	7	3	7	3	6	9	12	2	7
1/30	09.2°S	137.5°W	0600	97	09	26	02	2	1010.5	5	0.3	83.0	76.0	82.7	9	X	X	X	X	X	12	2	7
1/30	09.2°S	138.1°W	1200	97	09	15	00	2	1008.8	5	1.0	83.5	77.0	83.0	9	X	X	X	X	X	12	2	5
1/31	09.2°S	139.6°W	0000	98	03	06	15	6	1011.2	6	1.7	82.0	77.1	83.9	7	2	7	3	2	0	10	2	4
1/31	09.6°S	139.7°W	0600	97	06	16	00	1	1012.2	2	1.4	81.5	77.0	83.8	9	X	X	X	X	X	10	4	4
1/31	10.2°S	139.6°W	1200	97	08	14	00	1	1010.2	7	1.7	81.6	76.2	83.5	9	X	X	X	X	X	10	4	4
1/31	10.9°S	139.7°W	1800	98	09	16	01	2	1012.5	1	2.0	83.6	78.5	83.5	5	5	8	4	0	0	10	4	4
2/1	11.6°S	139.7°W	0000	98	08	20	02	1	1009.5	7	2.0	83.6	77.7	83.9	5	2	1	5	0	6	09	2	5
2/1	12.0°S	139.6°W	0600	97	06	16	01	1	1010.8	2	1.4	83.5	77.3	84.0	2	2	1	4	0	0	07	2	5
2/1	12.5°S	139.6°W	1200	97	08	15	00	1	1010.2	7	1.0	82.5	76.4	83.6	9	X	X	X	X	X	08	2	3
2/1	12.7°S	139.7°W	1800	98	08	15	01	1	1011.5	1	0.7	84.5	77.2	83.8	3	2	4	4	0	8	08	2	3
2/2	11.9°S	139.6°W	0000	98	06	12	03	1	1009.5	6	2.0	88.1*	78.5	84.0	6	3	2	5	0	5	08	2	3
2/2	11.3°S	139.7°W	0600	97	06	10	03	1	1010.8	7	2.0	85.0	77.2	83.9	2	2	1	4	0	0	06	2	3
2/2	10.7°S	139.6°W	1200	97	07	12	02	0	1010.2	7	1.4	83.2	77.0	84.0	2	2	1	4	0	0	07	2	3

*Questionable

Table 7.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 43 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
2/2	10.0°S	139.6°W	1800	98	05	12	03	0	1012.2	2	1.4	84.0	77.2	83.9	3	2	4	4	6	0	07	2	3
2/3	09.2°S	139.7°W	0000	99	07	13	02	1	1009.5	7	2.2	85.7	78.6	84.3	4	2	4	5	2	8	07	2	3
2/5	09.2°S	140.0°W	1800	99	10	18	00	0	1011.9	1	1.7	82.7	76.4	83.0	3	2	1	4	0	1	09	2	3
2/6	09.2°S	140.8°W	0000	99	09	21	02	0	1008.8	7	2.7	85.0	77.3	84.1	2	1	1	4	0	1	09	2	3
2/6	09.1°S	141.1°W	0600	98	09	20	02	0	1009.8	1	1.4	83.4	76.8	83.9	X	X	X	X	X	X	10	2	3
2/6	09.1°S	141.5°W	1200	98	11	18	02	0	1009.5	3	0.5	83.3	76.9	83.9	3	2	2	4	0	1	10	2	3
2/6	09.1°S	142.2°W	1800	98	09	17	03	0	1011.5	1	1.0	85.4	78.5	84.0	4	4	1	4	0	0	10	2	3
2/7	09.1°S	142.9°W	0000	98	10	16	01	0	1008.5	7	2.4	85.0	77.2	84.8	2	2	1	4	0	0	10	2	3
2/7	09.2°S	143.0°W	0600	98	10	16	00	0	1009.8	2	1.7	84.4	77.3	84.1	X	X	X	X	X	X	10	2	3
2/7	09.2°S	142.4°W	1200	98	09	14	00	0	1009.5	6	1.0	83.5	77.3	83.9	X	X	X	X	X	X	09	2	3
2/7	09.2°S	141.7°W	1800	98	10	21	02	0	1009.8	1	0.7	84.2	77.6	83.9	3	3	1	4	0	0	09	2	4
2/8	09.2°S	141.3°W	0000	98	08	18	03	0	1006.1	6	2.4	85.3	78.8	84.0	4	4	1	5	0	0	09	2	4
2/8	09.2°S	140.7°W	0600	98	09	16	00	0	1008.1	1	1.7	83.7	77.7	83.7	X	X	X	X	X	X	09	2	5
2/8	09.3°S	140.1°W	1200	98	11	17	00	0	1008.5	7	1.0	83.4	77.5	83.2	3	2	1	X	0	9	09	2	4
2/9	08.8°S	139.7°W	1800	99	08	17	02	0	1009.8	1	0.7	83.7	77.4	83.2	2	2	1	4	0	0	08	3	3
2/10	08.0°S	139.7°W	0000	99	08	17	02	0	1006.1	7	2.0	86.5	78.0	84.0	4	4	1	4	0	0	08	3	3
2/10	07.6°S	139.7°W	0600	98	07	20	02	1	1008.8	1	1.7	83.7	77.9	83.3	X	X	X	X	X	X	08	3	3
2/10	06.9°S	139.7°W	1200	98	07	13	01	0	1008.5	6	0.7	82.6	77.6	83.1	2	2	1	4	0	0	08	3	3
2/10	06.2°S	139.6°W	1800	98	09	18	02	0	1010.8	1	1.5	84.4	78.6	82.8	2	2	1	4	0	0	06	3	4
2/11	06.0°S	139.7°W	0000	98	09	12	02	0	1007.5	6	2.7	85.6	78.7	83.3	2	2	1	5	0	0	08	3	3
2/11	05.6°S	139.8°W	0600	98	11	13	80	0	1009.8	2	2.4	83.1	78.4	82.8	X	X	X	X	X	X	08	3	3
2/11	06.3°S	139.6°W	1200	98	11	10	03	1	1009.1	6	1.4	82.3	77.2	82.9	7	1	1	X	5	0	09	3	3
2/11	07.1°S	139.6°W	1800	98	08	14	01	1	1011.5	1	1.7	84.5	78.3	83.2	1	1	1	4	0	0	09	3	3
2/12	07.9°S	139.6°W	0000	98	11	14	03	8	1008.8	7	2.0	83.5	78.8	83.7	6	6	7	4	0	0	09	3	3
2/12	08.5°S	139.7°W	0600	98	11	13	00	1	1011.2	2	2.0	83.0	78.3	83.5	X	X	X	X	X	X	09	3	3
2/12	09.1°S	139.8°W	1200	98	07	17	01	0	1009.8	6	1.7	83.3	76.5	83.3	1	1	1	4	0	0	09	3	3
2/16	08.9°S	140.1°W	0000	98	06	14	00	1	1007.1	6	2.0	87.8	78.0	84.5	4	4	8	5	0	0	11	3	3
2/16	08.3°S	140.6°W	0600	97	07	15	01	0	1007.8	1	1.4	85.0	78.6	84.0	1	X	X	X	X	X	06	3	3
2/16	07.6°S	141.1°W	1200	97	07	17	02	0	1007.5	6	1.5	83.3	77.8	83.8	X	X	X	X	X	X	07	3	3
2/16	06.8°S	141.6°W	1800	98	09	19	01	0	1009.1	2	1.7	84.3	77.5	83.7	2	2	2	4	0	0	09	3	3
2/17	06.0°S	142.0°W	0000	98	08	17	01	0	1006.1	6	XX	85.3	76.5	83.7	1	1	1	5	0	0	06	3	4
2/17	05.2°S	142.4°W	0600	97	09	18	02	0	1007.8	2	2.4	83.7	77.0	83.1	X	X	X	X	X	X	08	3	4
2/17	04.5°S	142.8°W	1200	97	10	17	02	0	1008.1	6	0.9	82.5	77.2	82.8	3	X	X	X	X	X	09	3	4
2/17	03.7°S	143.4°W	1800	98	13	13	01	0	1009.5	2	1.4	84.5	77.8	82.8	1	1	1	4	0	1	13	3	3
2/18	02.9°S	143.8°W	0000	98	11	15	03	1	1007.1	7	2.4	83.6	77.3	82.8	6	1	8	5	7	0	08	3	3
2/18	02.1°S	144.1°W	0600	97	11	15	01	1	1008.5	2	2.0	83.0	78.1	82.3	1	X	X	X	X	X	08	3	3
2/18	01.2°S	144.6°W	1200	97	10	13	00	X	1008.1	6	1.5	82.2	77.7	82.3	X	X	X	X	X	X	08	3	3
2/18	00.4°S	145.1°W	1800	98	12	12	03	1	1010.5	2	2.7	83.0	78.4	81.7	6	6	4	4	0	0	10	3	3
2/19	00.5°N	145.5°W	0000	97	10	15	15	8	1007.5	7	2.5	83.3	79.4	82.0	7	1	8	4	7	0	11	3	3
2/19	01.4°N	146.0°W	0600	97	09	21	01	1	1009.1	1	2.0	83.0	78.2	82.5	2	X	X	X	X	X	09	3	4
2/19	02.1°N	146.3°W	1200	97	09	18	01	0	1008.1	6	1.5	82.5	77.7	82.5	2	X	X	X	X	X	09	3	4
2/19	03.0°N	146.7°W	1800	98	11	17	03	0	1010.2	1	2.0	84.8	79.0	82.9	3	2	4	4	6	0	11	3	4
2/20	03.8°N	147.0°W	0000	98	10	14	02	0	1008.1	7	2.0	86.2	79.8	83.8	2	1	2	4	6	0	10	3	4
2/20	04.7°N	147.4°W	0600	96	10	09	80	8	1009.8	1	2.4	80.6	76.8	82.7	X	X	X	X	X	X	10	3	4
2/20	05.4°N	147.6°W	1200	97	07	19	01	1	1009.1	6	1.4	82.5	78.5	82.8	2	X	X	X	X	X	08	3	4
2/20	06.2°N	148.0°W	1800	97	07	16	03	0	1011.2	1	2.2	83.6	78.4	82.7	3	2	2	5	0	5	07	3	4
2/21	07.1°N	148.3°W	0000	97	07	18	03	1	1010.2	6	1.4	82.5	77.8	83.2	7	7	7	4	0	0	07	3	4
2/21	07.8°N	148.6°W	0600	96	08	20	00	2	1012.2	2	2.0	82.8	76.5	82.1	9	X	X	X	X	X	08	3	4
2/21	08.6°N	149.1°W	1200	97	09	16	01	1	1011.9	6	0.7	81.5	75.6	81.6	2	X	X	X	X	X	08	3	4
2/21	09.4°N	149.7°W	1800	98	09	15	02	0	1014.6	1	1.5	82.6	75.6	81.3	2	2	4	4	6	0	07	3	4

Table 7.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 43 (cont'd)

					Wind		Weather		Pressure			Temperature			Clouds						Waves		
Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
2/22	10.3°N	150.2°W	0000	98	09	14	01	0	1012.5	7	1.9	84.0	76.5	81.8	1	1	8	4	0	0	08	3	4
2/22	11.1°N	150.7°W	0600	97	10	17	00	0	1013.9	2	2.0	82.2	76.2	80.0	9	X	X	X	X	X	08	3	4
2/22	11.9°N	151.0°W	1200	97	06	12	00	X	1014.6	7	0.7	79.0	74.7	78.3	9	X	X	X	X	X	06	3	4
2/22	12.8°N	151.4°W	1800	98	10	11	01	1	1016.3	2	2.0	80.4	74.7	78.0	3	2	1	4	0	1	07	3	2
2/23	13.7°N	151.9°W	0000	98	08	07	02	0	1014.2	7	2.4	80.2	74.2	79.0	2	2	1	4	0	0	08	3	2
2/23	14.5°N	152.5°W	0600	97	08	05	02	0	1015.2	2	1.4	80.8	74.7	79.4	2	X	X	X	X	X	09	3	2
2/23	15.2°N	153.0°W	1200	97	02	04	00	0	1015.2	7	0.7	78.8	73.5	78.4	9	X	X	X	X	X	49	X	X
2/23	16.0°N	153.6°W	1800	98	23	06	01	1	1016.9	2	1.9	77.2	73.3	77.9	2	1	2	5	3	0	29	2	2
2/24	16.7°N	154.2°W	0000	98	24	12	01	5	1015.6	7	1.4	78.0	72.5	77.5	3	2	2	4	0	1	29	3	2
2/24	17.4°N	154.8°W	0600	97	26	11	02	0	1015.9	2	1.4	77.0	72.0	77.1	1	X	X	X	X	X	27	3	2
2/24	18.0°N	155.4°W	1200	97	31	11	00	X	1015.2	7	1.0	76.0	70.5	76.0	9	X	X	X	X	X	49	X	X
2/24	18.8°N	156.0°W	1800	99	34	10	02	2	1016.9	2	1.7	75.2	71.3	76.2	7	4	2	5	6	0	30	2	2
2/25	19.4°N	156.5°W	0000	99	02	14	01	1	1015.9	7	1.4	76.0	71.0	77.0	4	3	4	4	6	0	02	2	3
2/25	20.0°N	157.1°W	0600	97	05	19	02	1	1018.0	1	2.7	74.0	69.4	76.3	3	X	X	X	X	X	04	3	4
2/25	20.7°N	157.6°W	1200	97	36	12	01	X	1019.3	6	0.3	72.1	66.0	75.2	9	X	X	X	X	X	01	3	3

Table 8.--Weather observations (USWB 1210-F), *Charles H. Gilbert* cruise 38[1]

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
2/8	21.8°N	158.0°W	1800	99	16	09	03	1	1015.2	2	0.7	73.0	68.3	73.3	6	5	4	5	6	1	32	5	3
2/9	21.6°N	158.7°W	0000	99	28	09	02	1	1015.2	8	0.7	76.1	70.3	74.8	4	2	4	5	8	0	17	5	2
2/9	21.4°N	158.6°W	0600	99	15	09	02	0	1015.2	4	0.0	74.3	72.1	75.2	X	X	X	X	X	X	XX	X	2
2/9	20.7°N	157.5°W	1800	99	14	08	02	0	1015.9	4	0.0	75.7	71.5	75.5	1	1	1	5	0	0	13	4	2
2/10	19.9°N	157.3°W	0000	99	12	02	02	0	1014.2	8	1.4	78.3	72.2	76.5	1	1	1	5	0	0	13	4	1
2/10	19.2°N	156.8°W	0600	98	13	03	02	0	1016.6	3	1.7	75.5	72.5	75.2	X	X	X	X	X	X	13	4	2
2/10	18.5°N	156.4°W	1200	99	09	08	02	0	1015.9	0	0.3	76.0	72.9	75.2	1	1	1	5	0	0	14	4	2
2/10	18.8°N	156.0°W	1800	99	10	09	02	0	1016.9	2	0.7	76.1	73.2	75.6	1	1	2	5	0	0	11	4	2
2/11	17.2°N	155.7°W	0000	99	08	14	03	1	1013.9	7	2.9	76.9	73.2	76.2	6	5	2	5	0	0	10	4	2
2/11	16.5°N	155.3°W	0600	99	07	16	00	1	1015.6	2	1.7	76.2	72.2	75.9	X	X	X	X	X	X	10	4	4
2/11	15.8°N	155.0°W	1200	99	08	17	00	X	1014.6	8	1.4	76.6	72.2	75.7	X	X	X	X	X	X	10	4	4
2/11	15.2°N	154.7°W	1800	99	08	19	01	1	1015.2	2	1.4	78.4	72.5	75.9	1	1	1	5	0	0	12	4	4
2/12	14.6°N	154.4°W	0000	99	08	19	03	1	1012.5	7	3.4	77.3	73.0	77.4	5	5	1	5	0	0	09	4	5
2/12	13.8°N	154.1°W	0600	99	08	21	02	2	1013.9	2	1.5	77.2	71.1	77.2	X	X	X	X	X	X	09	4	5
2/12	13.2°N	153.8°W	1200	99	06	17	00	X	1012.2	7	2.0	77.7	71.6	77.5	X	X	X	X	X	X	09	4	5
2/12	12.5°N	153.4°W	1800	99	08	18	03	X	1013.5	2	1.9	77.9	72.9	77.5	7	6	4	5	3	0	09	4	5
2/13	11.8°N	153.1°W	0000	99	07	21	01	1	1010.5	7	3.4	77.7	72.7	78.4	2	2	1	5	0	0	10	3	5
2/13	11.2°N	152.9°W	0600	99	07	16	02	0	1011.5	2	2.0	78.1	74.6	78.3	1	X	X	X	X	X	10	3	5
2/13	10.5°N	152.6°W	1200	99	08	17	02	0	1010.2	7	2.0	79.3	75.5	78.9	X	X	X	X	X	X	10	3	5
2/13	09.8°N	152.2°W	1800	98	05	14	14	1	1012.9	2	2.0	79.5	76.3	78.9	8	7	7	4	2	X	10	3	5
2/14	09.0°N	151.9°W	0000	98	07	18	21	6	1009.5	7	2.9	80.5	77.8	80.0	8	3	7	4	2	X	10	3	5
2/14	08.3°N	151.5°W	0600	98	09	10	00	6	1010.8	2	1.4	79.8	77.5	81.1	X	X	X	X	X	X	10	3	5
2/14	07.6°N	151.2°W	1200	98	08	13	00	X	1008.8	7	2.0	80.8	78.2	81.4	X	X	X	X	X	X	10	3	5
2/14	07.0°N	150.5°W	1800	98	12	22	62	X	1010.8	2	2.2	77.5	76.9	81.9	8	8	0	X	7	X	10	3	5
2/15	06.3°N	150.1°W	0000	99	10	10	01	6	1007.8	7	2.7	82.0	78.2	82.9	6	4	2	4	6	0	09	3	4
2/15	05.5°N	150.1°W	0600	99	10	07	00	2	1008.5	2	1.4	82.0	78.6	82.8	X	X	X	X	X	X	09	3	4
2/15	05.0°N	150.0°W	1200	99	09	08	00	X	1007.5	7	1.7	81.0	79.0	82.4	X	X	X	X	X	X	09	3	4
2/15	04.7°N	150.2°W	1800	99	09	12	00	X	1009.1	3	1.4	82.8	78.5	82.3	5	3	8	4	8	0	09	3	4
2/16	04.5°N	150.0°W	0600	99	08	08	00	0	1007.5	2	0.9	82.3	78.1	82.6	1	X	X	X	X	X	09	3	3
2/16	03.9°N	150.0°W	1800	99	11	10	03	X	1007.8	2	1.4	82.2	78.2	82.6	3	3	8	4	0	0	09	3	3
2/17	03.5°N	150.0°W	0600	99	11	13	00	X	1006.8	2	1.7	82.5	78.4	82.6	X	X	X	X	X	X	13	3	3
2/17	02.9°N	150.2°W	1800	99	16	16	01	X	1008.8	2	2.0	81.8	77.3	82.3	2	2	1	4	0	0	16	3	3
2/18	02.5°N	150.1°W	0600	99	12	12	00	X	1008.1	2	1.0	82.4	78.0	82.9	X	X	X	X	X	X	12	3	3
2/18	01.9°N	150.3°W	1800	99	11	10	03	X	1010.2	2	1.5	82.9	78.8	82.5	2	2	8	4	0	0	11	3	3
2/19	01.5°N	150.2°W	0600	99	13	05	00	X	1009.5	2	1.4	82.5	78.9	83.2	X	X	X	X	X	X	11	3	3
2/19	00.9°N	150.3°W	1800	99	12	18	01	1	1011.2	2	2.0	83.8	73.6*	82.4	4	3	2	4	1	X	11	3	5
2/20	00.6°N	150.2°W	0600	99	10	10	00	X	1009.8	2	1.4	82.2	78.3	82.2	X	X	X	X	X	X	11	3	4
2/20	00.1°N	150.1°W	1800	99	12	12	15	8	1011.2	2	1.4	82.1	79.3	82.1	6	5	3	4	6	X	12	3	3
2/21	00.2°S	150.0°W	0600	99	12	14	00	X	1010.2	2	2.0	82.2	78.5	82.1	X	X	X	X	X	X	12	3	4
2/21	00.8°S	150.2°W	1800	99	11	13	01	8	1011.5	3	2.0	82.2	78.2	82.2	3	3	2	4	0	0	10	3	4

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[1] All columns in USWB 1210-F are not included here. Those deleted are:

Column	2	Day of week	Column	23	Course of ship
"	3	Octant	"	24	Speed of ship
"	13	Barometer as read	"	31	Diff. sea-air, °F.
"	14	Barometer as corrected	"	32	Dew point, °F.
"	17	Air temperature, °F.			

*Questionable

Table 8.--Weather observations (USWB 1210-F), *Charles H. Gilbert* cruise 38 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
2/22	01.1°S	149.8°W	0600	99	06	15	00	X	1010.8	2	1.7	81.8	78.8	82.2	X	X	X	X	X	X	09	3	3
2/22	01.6°S	149.3°W	1200	99	05	16	00	X	1010.5	8	1.4	81.2	78.0	82.1	X	X	X	X	X	X	09	3	3
2/22	02.2°S	148.8°W	1800	99	07	16	01	8	1013.9	1	2.0	82.5	78.0	82.2	1	1	2	5	0	0	09	3	3
2/23	02.7°S	148.3°W	0000	99	06	14	02	0	1010.2	7	2.2	81.9	77.6	82.8	2	2	4	5	0	0	09	3	3
2/23	03.1°S	147.7°W	0600	99	06	10	00	1	1012.2	2	1.5	81.8	77.9	82.6	X	X	X	X	X	X	09	3	3
2/23	03.5°S	147.0°W	1200	99	05	13	00	X	1011.2	7	1.4	79.2	75.9	82.5	X	X	X	X	X	X	09	3	3
2/23	03.9°S	146.4°W	1800	99	05	12	03	8	1013.5	2	1.4	82.0	78.2	82.5	6	6	2	4	0	0	09	3	3
2/24	04.4°S	145.7°W	0000	99	04	06	15	8	1010.2	7	2.2	83.0	78.5	83.5	6	6	9	4	0	0	08	3	2
2/24	05.0°S	145.0°W	0600	99	04	09	00	1	1012.2	2	1.9	82.4	78.0	83.6	X	X	X	X	X	X	08	3	2
2/24	05.6°S	144.4°W	1200	99	03	13	00	X	1010.5	7	2.0	81.5	78.3	83.2	X	X	X	X	X	X	08	3	2
2/24	06.1°S	143.6°W	1800	99	04	11	02	X	1011.9	2	1.7	82.7	78.5	83.3	2	2	2	5	0	0	08	3	2
2/25	06.7°S	142.9°W	0000	99	04	12	03	1	1009.1	7	2.2	82.4	78.4	84.4	4	4	2	5	0	0	06	3	2
2/25	07.2°S	142.2°W	0600	99	04	11	00	1	1011.9	2	2.2	82.6	77.9	84.0	X	X	X	X	X	X	06	3	2
2/25	07.7°S	141.5°W	1200	99	03	07	00	X	1011.2	7	1.0	82.2	77.1	84.1	X	X	X	X	X	X	06	3	2
2/25	08.2°S	140.8°W	1800	99	04	06	01	1	1012.5	1	1.4	83.9	76.4	83.9	3	3	4	4	0	0	06	3	2
2/26	08.9°S	140.3°W	0000	99	05	06	02	0	1010.2	7	1.2	83.5	77.3	84.7	3	2	2	5	3	0	06	3	2
2/28	08.4°S	140.7°W	0000	99	35	07	01	X	1007.5	7	2.0	87.1	78.6	86.3	3	3	4	5	0	0	35	3	2
2/28	07.7°S	140.5°W	1800	99	36	13	02	1	1009.1	3	2.0	83.2	77.6	84.5	3	3	1	4	0	0	36	3	3
3/1	07.8°S	139.8°W	0000	99	34	09	03	1	1007.1	6	1.7	84.9	78.4	84.8	7	2	4	5	3	0	03	3	2
3/2	08.9°S	139.4°W	0000	99	33	09	03	2	1007.5	7	1.5	85.6	79.8	84.8	7	3	2	4	6	0	03	3	2
3/3	09.6°S	138.8°W	0000	99	06	07	01	1	1008.1	6	2.0	83.3	77.7	84.4	3	2	1	4	6	0	03	3	2
3/4	10.4°S	138.8°W	0000	99	06	12	03	1	1008.8	6	1.9	82.9	78.1	84.1	6	4	2	4	3	0	06	3	3
3/4	10.2°S	138.9°W	1800	99	07	14	01	X	1010.8	2	1.7	83.1	77.6	84.2	2	2	2	4	0	0	03	3	3
3/5	09.8°S	139.3°W	1800	98	04	17	25	8	1012.9	2	2.7	80.5	77.1	84.0	7	7	3	3	0	0	03	3	3
3/6	09.5°S	140.0°W	0000	99	04	07	01	1	1008.5	7	2.7	85.3	77.9	84.6	2	2	2	4	0	0	06	3	3
3/6	09.6°S	139.8°W	1800	99	08	17	03	8	1011.5	3	1.5	83.8	77.0	84.0	3	3	4	4	0	0	07	3	3
3/7	09.6°S	139.8°W	0600	99	07	19	01	0	1008.5	3	1.4	83.0	77.7	84.0	3	3	4	4	0	0	08	3	3
3/7	09.6°S	139.8°W	1200	99	11	08	02	0	1008.1	5	0.9	83.6	76.5	83.9	1	1	1	5	0	0	08	3	3
3/7	09.3°S	139.9°W	1800	99	07	09	03	8	1010.8	2	2.4	81.9	75.3	84.0	6	4	4	4	3	0	05	3	3
3/10	10.2°S	141.6°W	1800	99	10	19	03	X	1011.5	2	1.2	85.2	78.6	84.3	3	3	2	5	0	0	10	3	3
3/11	10.7°S	142.3°W	0000	99	10	14	02	0	1008.1	7	2.2	84.8	77.7	84.8	3	3	2	5	0	0	10	3	3
3/11	11.2°S	142.8°W	0600	99	09	14	00	0	1010.5	2	2.4	84.0	77.5	84.0	X	X	X	X	X	X	10	3	3
3/11	11.8°S	143.4°W	1200	99	06	12	00	X	1009.8	6	1.4	82.0	77.7	84.5	X	X	X	X	X	X	10	3	3
3/11	12.3°S	144.0°W	1800	99	13	10	03	8	1012.2	2	1.7	82.0	78.8	84.4	7	7	2	4	0	0	13	3	3
3/12	12.9°S	144.5°W	0000	99	10	07	02	2	1008.8	7	2.5	83.7	76.9	84.6	5	5	2	4	0	0	13	3	3
3/12	13.5°S	145.2°W	0600	99	10	10	00	1	1009.5	2	1.4	83.3	78.6	84.8	X	X	X	X	X	X	13	3	3
3/12	14.1°S	145.8°W	1200	99	10	14	03	X	1009.5	6	1.0	82.8	77.6	84.5	4	4	2	4	0	0	10	3	3
3/12	14.6°S	146.4°W	1800	99	10	10	01	1	1011.5	2	1.4	84.3	78.8	84.5	2	2	4	5	0	0	11	3	2
3/13	14.9°S	147.2°W	0000	99	13	07	03	1	1008.5	7	2.2	84.7	77.9	85.0	6	2	2	5	1	X	11	3	2
3/14	14.9°S	147.8°W	1800	99	08	10	03	X	1012.2	3	2.7	85.0	80.0	84.6	4	2	2	4	1	0	08	3	2
3/15	15.6°S	148.3°W	0000	99	08	14	25	8	1010.2	7	1.7	83.9	79.6	85.0	5	3	9	4	6	0	08	3	2
3/15	16.3°S	148.7°W	0600	99	10	13	00	2	1012.5	2	2.0	84.1	79.2	84.0	X	X	X	X	X	X	08	3	2
3/15	17.1°S	149.2°W	1200	99	08	17	00	X	1012.5	7	0.5	83.5	79.3	84.0	X	X	X	X	X	X	08	3	2
3/20	17.2°S	149.2°W	0000	99	12	12	03	X	1012.2	8	2.0	84.9	77.8	84.1	2	2	2	5	0	0	09	3	2
3/20	16.7°S	148.7°W	0600	99	12	15	00	1	1012.9	2	1.0	84.5	77.9	83.9	X	X	X	X	X	X	09	3	2
3/20	16.2°S	148.1°W	1200	99	10	14	00	X	1011.5	7	1.0	83.8	77.0	84.1	X	X	X	X	X	X	09	3	2
3/20	15.7°S	147.6°W	1800	99	11	12	03	X	1013.5	2	1.5	86.5	78.3	84.0	2	2	2	5	0	0	09	3	2
3/21	15.3°S	147.0°W	0000	99	09	18	02	0	1010.5	7	2.0	84.4	77.3	84.7	2	2	1	4	0	0	09	3	2
3/21	14.8°S	146.4°W	0600	99	09	14	00	0	1012.5	2	1.7	84.6	78.6	84.5	X	X	X	X	X	X	09	3	2
3/21	14.2°S	145.8°W	1200	99	10	15	00	X	1011.2	7	1.4	83.6	77.8	84.4	X	X	X	X	X	X	09	3	2

Table 8.--Weather observations (USWB 1210-F), *Charles H. Gilbert* cruise 38 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
3/21	13.7°S	145.3°W	1800	99	10	14	03	X	1013.9	2	2.4	83.9	78.0	84.3	4	4	4	4	0	0	09	3	2
3/22	13.1°S	144.8°W	0000	99	10	12	02	1	1011.2	7	2.0	84.0	78.5	85.0	4	4	2	4	0	0	09	3	3
3/22	12.6°S	144.3°W	0600	99	12	14	00	1	1012.9	2	2.2	85.3	79.1	84.4	X	X	X	X	X	X	09	3	3
3/22	12.0°S	143.8°W	1200	99	10	20	00	X	1010.8	7	2.0	83.5	77.2	84.4	X	X	X	X	X	X	09	3	3
3/22	11.5°S	143.3°W	1800	99	09	15	03	X	1012.5	2	2.0	84.9	78.9	84.1	3	2	2	4	1	0	09	3	4
3/23	11.0°S	142.7°W	0000	99	09	16	02	0	1009.5	7	2.0	85.3	78.8	85.0	3	3	2	4	0	0	09	3	4
3/23	10.5°S	142.1°W	0600	99	12	14	00	0	1011.5	2	2.0	85.7	77.8	84.4	X	X	X	X	X	X	09	3	4
3/23	10.1°S	141.6°W	1200	99	11	20	00	X	1009.5	7	1.9	84.8	77.5	84.2	X	X	X	X	X	X	09	3	5
3/23	09.7°S	141.1°W	1800	99	11	17	03	X	1011.2	2	1.4	85.5	78.2	84.4	2	2	1	4	0	0	09	3	4
3/24	09.3°S	140.6°W	0000	99	10	18	02	0	1007.5	7	2.4	84.8	78.2	84.9	2	2	1	4	0	0	09	3	5
3/26	09.2°S	139.4°W	1800	99	12	14	03	X	1012.2	0	1.4	85.7	79.8	84.0	3	3	2	4	0	0	10	3	2
3/27	09.2°S	138.8°W	0000	98	14	19	03	5	1008.5	6	1.4	84.1	78.0	83.9	5	3	5	4	6	0	10	3	4
3/27	09.2°S	138.2°W	0600	98	08	09	00	2	1011.5	2	1.0	84.2	76.0	83.8	X	X	X	X	X	X	10	3	3
3/27	09.2°S	137.5°W	1200	98	09	10	00	X	1009.5	8	1.0	82.7	75.6	83.8	X	X	X	X	X	X	10	3	3
3/27	09.2°S	137.0°W	1800	99	11	08	01	1	1012.5	1	1.2	86.3	78.1	83.8	3	3	2	4	0	0	09	3	3
3/28	09.2°S	136.3°W	0000	99	08	09	03	1	1009.1	7	1.4	84.9	77.9	84.1	4	4	4	4	0	0	09	3	3
3/28	09.2°S	136.2°W	0600	98	08	11	50	5	1011.9	2	1.7	80.8	76.8	83.8	X	X	X	X	X	X	09	3	3
3/28	09.1°S	136.9°W	1200	98	07	12	00	X	1009.5	7	1.7	82.8	77.7	83.7	X	X	X	X	X	X	09	3	3
3/28	09.0°S	137.5°W	1800	99	05	14	02	0	1011.5	1	1.0	85.7	80.5	84.0	2	2	1	4	0	0	09	3	3
3/29	09.1°S	138.2°W	0000	99	10	14	02	0	1008.8	7	2.0	85.1	79.9	84.4	2	2	2	4	0	0	09	3	3
3/29	09.1°S	138.9°W	0600	98	10	14	00	1	1011.2	2	1.9	84.0	77.5	84.0	X	X	X	X	X	X	09	3	3
3/29	09.1°S	139.4°W	1200	98	09	14	00	X	1009.5	7	1.4	85.0	78.9	84.2	X	X	X	X	X	X	09	3	3
3/29	08.7°S	139.7°W	1800	99	09	12	02	0	1010.2	1	0.2	85.7	80.2	84.2	1	1	1	4	0	0	08	3	3
3/30	07.5°S	139.8°W	0600	99	10	09	00	0	1010.2	2	2.4	84.1	79.2	85.2	X	X	X	X	X	X	08	3	3
3/30	06.9°S	139.7°W	1200	98	10	10	00	X	1009.1	7	1.4	83.5	78.9	83.9	X	X	X	X	X	X	08	3	3
3/30	06.4°S	139.7°W	1800	99	09	14	03	0	1011.2	2	2.0	83.3	79.2	83.3	4	4	1	4	0	0	08	3	3
3/31	05.7°S	139.6°W	0000	98	08	13	01	6	1008.5	7	1.4	84.4	79.0	83.5	5	5	2	4	0	0	08	3	3
3/31	05.7°S	139.7°W	0600	98	11	12	00	8	1011.2	2	2.0	83.0	78.6	83.2	X	X	X	X	X	X	08	3	3
3/31	06.3°S	139.6°W	1200	98	09	11	00	X	1010.2	7	1.4	82.8	78.6	83.2	X	X	X	X	X	X	08	3	3
3/31	07.0°S	139.7°W	1800	99	08	13	03	1	1012.9	2	2.0	84.1	79.0	83.6	5	2	1	4	3	0	08	3	3
4/1	07.6°S	139.6°W	0000	99	04	13	03	1	1009.5	7	2.7	83.9	78.9	84.4	5	4	1	4	3	0	08	3	3
4/1	08.2°S	139.7°W	0600	98	07	09	00	1	1011.9	2	1.9	83.8	79.1	84.3	X	X	X	X	X	X	08	3	3
4/1	08.6°S	140.0°W	1200	99	06	09	02	X	1010.2	6	1.4	83.5	78.1	84.3	1	1	1	4	0	0	08	3	3
4/3	09.1°S	140.0°W	1800	99	08	14	02	0	1012.2	2	1.4	83.1	77.8	84.2	1	1	1	4	0	0	08	3	3
4/4	09.2°S	140.7°W	0000	99	07	11	02	0	1007.8	7	2.5	87.2	78.0	85.1	1	1	1	4	0	0	08	3	3
4/4	09.2°S	141.2°W	0600	98	14	06	02	0	1011.2	2	2.0	84.1	78.0	84.6	2	2	1	4	0	0	08	3	2
4/4	09.1°S	141.9°W	1200	98	34	06	02	1	1010.5	8	1.2	83.5	75.4	84.8	1	1	1	4	0	0	08	3	2
4/4	09.1°S	142.5°W	1800	99	04	06	02	0	1012.5	2	1.9	83.3	75.7	84.7	1	1	1	4	0	0	08	3	2
4/5	09.1°S	143.2°W	0000	99	35	03	03	1	1009.5	7	2.4	85.4	77.0	87.7	5	3	1	4	0	2	08	3	2
4/5	09.1°S	143.0°W	0600	99	09	04	01	1	1009.5	3	0.9	84.1	76.9	86.0	2	X	X	X	X	X	08	3	2
4/5	09.1°S	142.5°W	1200	98	08	07	03	1	1009.1	7	1.0	82.3	75.2	84.7	4	4	2	4	0	0	08	3	2
4/5	09.1°S	141.8°W	1800	99	07	08	02	1	1010.8	2	1.5	84.4	76.3	84.7	3	3	2	4	0	0	08	3	2
4/6	09.1°S	141.1°W	0000	99	06	06	02	0	1006.8	7	2.7	85.5	77.3	86.0	3	3	2	4	0	0	06	3	2
4/6	09.1°S	140.5°W	0600	98	15	05	02	0	1008.8	2	1.5	83.5	75.1	85.6	2	2	2	4	0	0	06	3	1
4/6	09.2°S	140.0°W	1200	98	02	11	02	0	1008.5	6	0.7	82.4	75.9	84.5	2	2	2	4	0	0	06	3	2
4/6	09.6°S	139.7°W	1800	99	03	15	02	0	1009.8	2	0.7	86.2	77.9	84.5	1	1	2	4	0	0	06	3	3
4/7	10.3°S	139.7°W	0000	99	36	14	02	0	1006.8	7	1.7	83.4	77.2	84.8	2	1	1	4	0	0	06	3	3
4/7	10.9°S	139.7°W	0600	99	35	07	00	X	1009.5	2	2.0	84.3	77.3	85.0	X	X	X	X	X	X	05	3	3
4/7	11.5°S	139.8°W	1200	98	02	05	00	X	1008.5	6	1.0	80.5	76.2	84.2	3	X	X	X	X	X	05	3	3
4/7	12.1°S	139.8°W	1800	98	08	10	60	6	1011.2	2	1.7	81.2	77.8	84.0	8	2	2	4	2	X	14	3	3

Table 8.--Weather observations (USWB 1210-F), Charles H. Gilbert cruise 38 (cont'd)

					Wind		Weather		Pressure			Temperature			Clouds						Waves		
Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
4/8	12.7°S	139.8°W	0000	99	09	05	01	6	1008.5	7	2.5	82.7	78.2	85.2	3	1	1	4	8	8	12	3	3
4/8	12.5°S	139.7°W	0600	98	11	05	00	0	1010.5	2	2.0	83.8	77.6	84.3	X	X	X	X	X	X	15	3	3
4/8	12.0°S	139.7°W	1200	98	09	11	00	X	1009.8	7	0.9	83.9	77.6	84.2	X	X	X	X	X	X	15	3	3
4/8	11.4°S	139.7°W	1800	99	06	08	01	X	1011.9	2	1.4	83.8	76.8	83.9	2	1	2	4	0	8	15	3	3
4/9	11.7°S	139.7°W	0000	99	04	08	02	0	1008.5	7	2.0	86.5	77.5	85.3	2	2	2	4	0	0	15	3	2
4/9	10.0°S	139.7°W	0600	98	07	04	00	X	1010.5	2	1.9	84.1	75.6	85.1	X	X	X	X	X	X	15	3	2
4/9	09.4°S	139.9°W	1200	99	07	09	01	1	1009.8	8	0.7	82.9	77.3	84.4	2	2	2	4	0	0	15	3	2
4/11	08.8°S	140.5°W	1800	99	08	08	02	0	1011.5	2	1.0	83.8	78.2	84.8	2	2	2	4	0	0	01	3	2
4/12	08.3°S	140.7°W	0000	99	07	09	03	1	1008.5	6	2.0	86.2	79.0	85.2	5	5	2	4	0	0	02	3	2
4/12	07.7°S	140.5°W	1800	98	10	09	80	X	1012.9	2	1.5	84.9	78.8	84.7	6	6	3	4	0	0	06	3	2
4/13	08.1°S	139.7°W	0600	98	11	14	00	1	1010.8	1	1.4	84.0	78.2	84.8	X	X	X	X	X	X	11	3	4
4/13	08.4°S	139.6°W	1800	99	08	15	01	X	1013.5	2	1.5	84.2	77.4	84.4	2	2	2	4	0	0	10	3	4
4/14	08.8°S	139.5°W	0000	99	09	13	02	0	1009.1	7	2.4	83.5	76.7	84.6	1	1	1	4	0	0	12	3	4
4/14	09.3°S	139.2°W	1800	99	05	10	03	X	1013.5	2	1.7	84.8	77.2	84.4	4	2	2	4	6	0	10	3	3
4/15	09.9°S	139.0°W	1800	99	10	15	02	X	1013.2	2	1.7	84.2	76.7	83.9	6	6	4	4	0	0	10	3	3
4/16	10.3°S	138.7°W	0000	99	10	15	02	2	1009.1	7	2.4	83.6	75.9	84.1	6	2	2	4	6	0	08	3	3
4/16	10.3°S	138.9°W	1800	98	06	15	14	6	1012.5	2	2.4	84.2	78.0	84.0	6	2	3	4	6	0	06	3	3
4/17	09.8°S	139.4°W	1800	98	10	11	14	X	1013.5	2	1.7	83.8	78.6	84.0	7	2	3	4	2	X	06	3	3
4/18	09.6°S	139.8°W	0000	99	08	09	02	1	1010.5	7	2.0	86.4	79.0	85.2	3	3	2	4	0	0	06	3	2
4/18	09.6°S	139.8°W	0600	98	05	12	00	1	1012.9	2	1.4	83.8	77.1	84.5	X	X	X	X	X	X	06	3	2
4/18	09.5°S	139.9°W	1200	98	07	11	00	8	1011.2	7	1.0	82.8	77.5	84.6	X	X	X	X	X	X	06	3	3
4/18	09.6°S	139.8°W	1800	99	08	08	02	X	1013.2	2	1.2	83.2	78.2	84.4	1	1	1	4	0	0	08	3	3
4/22	08.7°S	140.4°W	0000	99	26	03	03	X	1010.8	7	2.4	88.5*	80.9	85.4	3	3	2	4	0	0	06	3	2
4/22	08.0°S	140.8°W	0600	98	08	14	00	1	1012.9	2	1.9	84.4	79.8	84.9	X	X	X	X	X	X	07	3	2
4/22	07.4°S	141.2°W	1200	98	09	13	00	X	1011.2	7	1.7	84.4	79.3	84.7	X	X	X	X	X	X	07	3	2
4/22	06.8°S	141.6°W	1800	99	09	15	02	X	1012.9	2	1.7	84.5	79.1	84.7	3	3	1	4	0	0	07	3	3
4/23	06.1°S	142.0°W	0000	99	11	10	02	0	1008.8	7	2.4	84.3	81.4	84.6	3	3	1	4	0	0	10	3	3
4/23	05.4°S	142.4°W	0600	99	08	10	00	6	1010.5	1	1.4	82.8	79.5	84.2	X	X	X	X	X	X	10	3	3
4/23	04.7°S	142.8°W	1200	99	06	08	00	6	1008.8	7	1.7	80.0	78.1	83.3	X	X	X	X	X	X	09	3	3
4/23	04.0°S	143.2°W	1800	99	05	11	03	1	1011.5	2	2.4	84.5	79.8	83.4	5	3	2	4	3	0	06	3	3
4/24	03.3°S	143.7°W	0000	99	02	10	14	8	1009.1	7	2.0	83.4	78.6	83.7	7	3	3	4	3	0	08	3	3
4/24	02.6°S	144.2°W	0600	98	25	03	00	2	1010.5	2	1.0	80.8	77.8	83.0	X	X	X	X	X	X	08	3	3
4/24	01.9°S	144.6°W	1200	98	03	04	00	X	1008.1	7	2.0	82.2	77.1	83.1	X	X	X	X	X	X	08	3	3
4/24	01.2°S	145.1°W	1800	99	09	07	02	0	1009.8	2	1.7	83.0	78.1	82.7	2	2	1	4	0	0	08	3	3
4/25	00.4°S	145.5°W	0000	99	10	05	02	0	1007.1	7	2.2	84.0	78.1	83.8	1	1	1	4	0	0	08	3	3
4/25	00.4°N	145.9°W	0600	99	10	08	00	0	1008.5	2	2.0	82.2	78.1	82.5	X	X	X	X	X	X	08	3	3
4/25	01.0°N	146.3°W	1200	98	13	14	00	X	1007.5	7	1.7	81.9	78.2	82.3	X	X	X	X	X	X	08	3	3
4/25	01.8°N	146.8°W	1800	99	12	13	03	X	1009.1	2	2.0	84.4	80.0	82.7	4	3	2	4	3	0	08	3	3
4/26	02.5°N	147.3°W	0000	99	12	09	02	2	1006.8	7	1.9	84.0	80.3	83.8	5	3	2	4	1	0	08	3	3
4/26	03.3°N	147.7°W	0600	98	18	09	00	2	1008.8	2	2.0	83.3	78.6	83.4	X	X	X	X	X	X	08	3	3
4/26	04.9°N	148.0°W	1200	98	34	09	60	6	1007.8	8	1.2	80.2	77.9	82.5	X	X	X	X	X	X	08	3	3
4/26	04.6°N	148.4°W	1800	98	36	06	50	6	1010.5	2	1.5	79.4	76.6	81.5	7	1	1	4	7	0	03	3	3
4/27	05.3°N	148.8°W	0000	98	07	18	14	2	1008.1	7	3.1	81.5	78.2	82.5	8	1	1	4	7	X	04	3	4
4/27	06.0°N	149.1°W	0600	98	08	13	00	2	1010.2	2	2.0	80.2	77.1	82.2	X	X	X	X	X	X	03	3	4
4/27	06.7°N	149.4°W	1200	98	06	13	00	6	1008.5	7	1.7	80.2	78.6	82.0	X	X	X	X	X	X	04	3	4
4/27	07.4°N	149.9°W	1800	97	05	19	60	6	1011.2	2	2.0	79.6	77.7	81.5	8	3	7	4	2	X	04	3	4
4/28	08.1°N	150.3°W	0000	97	06	18	21	6	1008.8	7	2.0	83.1	78.4	81.1	7	3	7	4	2	0	04	3	4
4/28	08.9°N	150.7°W	0600	97	06	17	00	6	1009.8	2	1.4	80.0	77.0	81.0	X	X	X	X	X	X	04	3	5
4/28	09.5°N	151.2°W	1200	97	08	20	00	X	1009.1	6	1.2	79.5	76.3	80.9	X	X	X	X	X	X	04	3	5
4/28	10.2°N	151.6°W	1800	98	06	16	03	X	1011.2	2	1.7	79.0	76.2	80.4	3	2	1	4	0	6	04	3	5

*Questionable

Table 8.--Weather observations (USWB 1210-F), Charles H. Gilbert cruise 38 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
4/29	11.0°N	152.1°W	0000	99	07	16	02	1	1009.5	7	1.7	81.2	77.0	80.5	5	5	2	4	0	0	05	3	5
4/29	11.7°N	152.5°W	0600	98	06	16	00	2	1011.5	2	2.2	79.8	75.6	80.3	X	X	X	X	X	X	05	3	4
4/29	12.4°N	152.9°W	1200	99	07	19	00	6	1010.2	7	2.0	78.0	74.6	79.3	X	X	X	X	X	X	05	3	4
4/29	13.1°N	153.3°W	1800	99	08	16	03	X	1012.9	2	2.0	78.9	74.0	79.0	5	3	2	4	6	0	05	3	4
4/30	13.9°N	153.7°W	0000	98	08	14	03	2	1011.5	8	1.9	79.4	73.6	78.2	7	1	1	4	7	0	05	3	4
4/30	14.7°N	154.1°W	0600	98	08	15	00	2	1013.2	2	1.9	77.7	73.1	77.9	X	X	X	X	X	X	05	3	3
4/30	15.3°N	154.5°W	1200	98	06	17	00	X	1012.9	7	1.4	76.0	73.1	77.5	X	X	X	X	X	X	05	3	3
4/30	16.1°N	154.9°W	1800	98	06	19	03	X	1014.9	2	2.0	77.1	73.2	77.3	7	7	4	4	0	0	05	3	3
5/1	16.9°N	155.3°W	0000	99	06	15	02	2	1013.9	7	1.7	78.5	72.3	77.0	5	4	4	4	0	1	05	3	4
5/1	17.7°N	155.7°W	0600	98	06	18	00	2	1015.2	2	2.0	75.9	71.7	77.0	X	X	X	X	X	X	05	3	4
5/1	18.3°N	156.0°W	1200	99	07	22	00	X	1014.2	8	1.7	74.2	70.5	75.5	1	X	X	X	X	X	05	3	5
5/1	19.0°N	156.4°W	1800	98	23	04	03	X	1016.3	2	1.7	75.5	70.7	76.8	3	3	4	4	0	0	16	3	3
5/2	19.8°N	156.7°W	0000	99	06	16	01	0	1014.6	7	1.9	77.1	72.2	76.3	2	2	1	4	0	8	04	3	4
5/2	20.7°N	157.2°W	0600	99	08	12	80	1	1015.2	2	1.7	76.4	70.4	76.7	4	4	4	4	0	0	08	3	3

Table 9.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 45[1/]

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
3/29	21.0°N	157.6°W	0600	98	06	25	01	2	1019.0	3	1.0	72.5	66.3	74.3	6	2	1	5	8	1	05	3	4
3/29	20.3°N	157.3°W	1200	98	06	22	00	2	1019.3	7	1.0	73.0	67.2	74.2	4	4	X	X	X	X	XX	X	X
3/29	19.7°N	156.5°W	1800	98	06	17	01	1	1018.0	3	1.0	74.1	67.8	75.3	2	1	1	4	8	1	04	2	4
3/30	19.0°N	156.0°W	0000	98	17	12	15	1	1015.9	7	2.0	78.0	68.4	76.2	6	4	4	5	0	5	14	2	1
3/30	18.5°N	155.4°W	0600	97	02	28	02	2	1018.0	2	2.0	73.8	68.0	74.4	8	8	5	4	X	X	08	3	4
3/30	18.0°N	154.9°W	1200	97	06	21	01	1	1017.6	3	1.4	73.0	68.3	74.6	2	2	1	5	0	0	06	2	3
3/30	17.4°N	154.3°W	1800	99	06	20	01	1	1018.0	1	2.0	74.5	69.8	75.7	3	3	4	4	0	0	06	2	3
3/31	16.8°N	153.6°W	0000	97	07	20	15	1	1015.6	7	2.4	76.0	70.8	75.5	3	3	9	5	0	2	06	2	4
3/31	16.2°N	153.1°W	0600	97	07	24	18	6	1016.6	3	1.4	71.8	70.2	75.3	8	8	4	4	X	X	06	3	5
3/31	15.6°N	152.5°W	1200	97	08	28	15	8	1016.6	8	1.4	73.7	69.7	75.6	6	3	9	4	0	6	04	4	5
3/31	15.3°N	152.0°W	1800	98	06	26	02	1	1017.3	1	2.0	75.1	69.7	76.2	2	1	1	4	4	X	04	4	5
4/1	14.7°N	151.6°W	0000	97	06	27	15	1	1014.9	7	2.7	77.0	71.5	76.7	7	2	9	5	0	0	06	3	6
4/1	14.2°N	151.0°W	0600	97	07	27	02	1	1015.6	3	1.4	74.5	71.3	77.1	4	4	2	5	0	0	07	3	5
4/1	13.8°N	150.5°W	1200	97	07	24	01	0	1014.9	6	1.7	75.2	70.5	77.4	3	3	2	5	0	0	08	3	7
4/1	13.2°N	149.9°W	1800	98	07	26	15	1	1015.2	1	2.0	76.8	72.0	77.4	6	2	1	4	7	1	07	4	5
4/2	12.7°N	149.3°W	0000	97	07	25	16	8	1011.5	8	3.4	77.5	73.5	79.0	6	5	9	4	6	0	08	3	5
4/2	12.2°N	148.8°W	0600	97	08	24	18	8	1013.5	2	2.4	77.0	73.1	79.2	7	7	5	4	0	0	08	3	5
4/2	11.7°N	148.3°W	1200	97	07	27	02	2	1012.5	7	2.4	77.2	73.0	79.6	6	2	2	4	0	9	08	3	4
4/2	11.2°N	147.7°W	1800	98	07	24	03	1	1012.9	2	2.0	78.1	72.2	79.0	2	1	2	4	4	9	07	4	4
4/3	10.6°N	147.1°W	0000	97	06	24	01	0	1011.5	7	3.1	79.0	73.5	80.1	2	2	2	5	0	1	06	3	4
4/3	10.1°N	146.5°W	0600	98	07	24	03	0	1013.2	2	2.0	78.1	73.2	78.5	3	3	2	5	0	0	07	3	4
4/3	09.7°N	145.9°W	1200	97	05	25	03	1	1011.9	7	2.2	78.0	73.1	78.5	7	1	1	5	3	0	09	4	3
4/3	09.2°N	145.3°W	1800	97	05	24	01	1	1012.5	1	2.0	78.8	74.1	79.0	6	4	4	4	0	5	05	4	4
4/4	08.6°N	144.7°W	0000	97	05	25	14	8	1009.5	7	2.7	79.5	74.0	80.0	7	7	4	4	0	6	06	5	5
4/4	08.1°N	144.2°W	0600	97	05	20	02	2	1012.5	2	2.7	78.2	75.2	80.4	8	8	4	4	X	X	06	4	5
4/4	07.6°N	143.6°W	1200	97	06	26	02	2	1009.5	7	2.7	78.8	75.2	80.8	8	8	5	4	X	X	04	3	6
4/4	07.1°N	143.0°W	1800	97	05	24	02	2	1011.5	2	2.0	81.6	76.6	81.6	4	3	4	4	8	9	07	3	5
4/5	06.6°N	142.6°W	0000	96	06	25	25	8	1008.1	7	3.4	81.0	78.0	81.8	8	8	7	4	X	X	06	3	6
4/5	06.1°N	141.7°W	0600	96	04	16	52	5	1009.5	2	2.0	80.0	77.5	82.0	8	8	4	4	X	X	06	3	5
4/5	05.7°N	141.0°W	1200	96	06	18	50	5	1007.1	7	2.5	80.3	78.0	81.7	8	8	7	4	X	X	07	2	4
4/5	05.3°N	140.3°W	1800	97	11	13	51	2	1009.8	1	2.7	81.2	78.0	81.5	8	7	2	4	3	X	08	3	3
4/6	04.6°N	140.0°W	0000	97	01	20	20	2	1007.1	7	2.4	81.5	78.0	83.8	7	7	2	5	0	0	08	3	2
4/6	04.0°N	140.0°W	0600	97	23	02	01	1	1009.5	2	2.0	80.9	77.0	82.2	3	3	4	5	X	X	09	2	1
4/6	03.7°N	140.0°W	1200	97	31	07	03	2	1008.5	7	2.0	80.7	76.5	81.7	7	7	4	4	X	X	03	2	2
4/7	02.8°N	140.0°W	0000	97	10	10	01	1	1006.4	7	2.7	82.7	77.5	83.0	3	3	3	5	0	0	03	3	2
4/7	02.1°N	140.0°W	0500	97	11	10	01	8	1007.8	2	1.7	82.2	77.0	82.6	3	X	X	X	X	X	13	2	2
4/7	01.8°N	140.1°W	1200	97	12	09	00	0	1007.1	6	1.4	81.9	77.5	82.0	3	3	3	4	0	0	15	2	2
4/7	01.0°N	140.0°W	1700	97	12	14	02	8	1008.8	2	2.0	82.0	77.2	81.1	3	2	3	4	6	0	12	2	2
4/8	00.8°N	140.0°W	0000	97	13	11	01	0	1006.4	7	1.7	82.0	77.4	81.8	2	2	1	5	0	0	13	2	2
4/8	00.0°N	140.1°W	0600	97	13	12	00	0	1009.8	2	2.7	80.5	77.0	80.9	1	X	X	X	X	X	13	2	2

[1/] All columns in USWB 1210-F are not included here. Those deleted are:

Column	2	Day of week	Column	23	Course of ship
"	3	Octant	"	24	Speed of ship
"	13	Barometer as read	"	31	Diff. sea-air, °F.
"	14	Barometer as corrected	"	32	Dew point, °F.
"	17	Air temperature, °F.			

Table 9.--Weather observations (USWB 1210-F), *Hugh M. Smith* cruise 45 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
4/8	00.0°	140.1°W	1200	97	07	12	02	0	1008.5	6	2.0	81.6	77.1	80.7	1	1	1	4	X	X	07	2	2
4/9	00.9°S	140.0°W	0000	97	10	10	03	0	1007.1	7	2.0	82.0	77.3	81.7	3	2	3	4	0	0	13	2	1
4/9	01.2°S	140.0°W	0600	97	12	12	00	1	1009.5	2	1.4	82.0	76.6	81.6	7	X	X	X	X	X	14	2	2
4/9	02.0°S	140.0°W	1200	97	12	13	01	1	1007.8	7	1.4	81.5	77.5	81.6	3	3	3	4	X	X	13	2	2
4/9	02.2°S	140.0°W	1800	97	13	12	02	8	1010.8	2	1.4	83.2	78.8	82.0	3	2	2	4	6	0	14	2	2
4/10	03.0°S	140.0°W	0000	97	11	12	01	0	1007.1	7	2.4	84.0	78.0	82.3	1	1	1	5	0	0	14	2	2
4/10	03.0°S	140.0°W	0700	97	16	12	00	0	1010.2	2	2.7	82.2	77.5	82.1	1	X	X	X	X	X	14	2	2
4/10	03.8°S	140.1°W	1200	97	09	08	02	0	1009.1	7	1.4	82.2	77.0	82.3	1	1	1	4	X	X	14	2	2
4/10	04.0°S	140.0°W	1800	97	06	12	01	1	1011.5	0	1.4	84.6	78.1	82.5	2	2	1	4	0	0	07	2	2
4/11	03.4°S	140.0°W	0000	97	09	09	02	0	1007.5	7	2.4	84.8	77.8	83.0	1	1	1	5	0	0	12	2	2
4/11	02.4°S	140.0°W	0600	97	06	12	00	0	1010.8	1	2.7	81.6	76.2	81.8	1	X	X	X	X	X	12	2	2
4/11	01.5°S	140.0°W	1200	97	08	08	00	0	1009.1	6	1.0	81.0	76.5	81.5	1	1	1	X	X	X	15	2	2
4/11	00.6°S	140.0°W	1800	97	11	08	02	0	1011.5	1	1.4	82.0	76.4	80.9	2	2	1	4	0	0	04	2	2
4/12	00.0°	140.0°W	0000	97	11	08	02	0	1007.8	6	2.0	81.2	77.0	81.4	1	1	1	4	0	8	09	2	2
4/12	00.0°	140.0°W	0600	97	11	12	02	0	1010.8	1	2.7	80.2	75.5	80.6	1	1	X	X	X	X	14	2	2
4/12	00.0°	140.0°W	1200	97	12	08	00	0	1009.1	6	1.4	80.3	75.6	80.5	1	1	1	4	X	X	14	2	2
4/12	00.0°	140.0°W	1900	97	10	08	02	0	1012.5	1	1.4	81.9	76.4	80.6	2	1	1	4	6	0	17	2	2
4/13	00.0°	140.0°W	0000	97	14	10	02	0	1008.5	7	1.7	81.2	76.2	81.2	2	1	1	5	6	0	10	2	2
4/13	00.0°	140.0°W	0600	97	11	10	00	0	1010.5	2	2.0	80.2	75.2	80.6	1	X	X	X	X	X	12	2	2
4/13	00.0°	140.0°W	1200	97	09	10	00	0	1009.5	6	1.4	81.0	76.0	80.5	1	1	1	4	X	X	10	2	2
4/13	00.0°	140.0°W	1800	97	18	10	02	0	1013.2	1	2.0	81.8	76.3	80.5	1	1	1	4	0	0	14	2	2
4/14	00.0°	140.0°W	0000	97	10	06	02	0	1009.1	7	2.0	81.7	75.0	82.8	1	1	1	5	0	0	14	2	1
4/14	00.0°	140.0°W	0600	97	19	08	02	0	1011.9	2	2.0	80.5	75.2	81.1	1	1	X	X	X	X	13	2	1
4/14	00.0°	140.0°W	1200	97	10	08	02	0	1009.8	6	2.4	80.0	76.5	80.8	1	1	1	4	X	X	14	2	1
4/14	00.0°	140.0°W	1800	97	11	08	02	0	1012.9	1	1.7	81.0	76.0	80.8	1	1	1	4	0	0	16	2	1
4/15	00.0°	140.0°W	0000	97	10	07	02	0	1009.1	7	2.0	82.1	75.8	82.1	1	1	1	5	0	0	14	2	1
4/15	00.0°	140.0°W	0600	97	11	12	00	0	1010.5	2	1.7	80.0	76.2	80.9	1	1	X	X	X	X	17	2	1
4/15	00.0°	140.0°W	1200	97	09	10	00	0	1009.1	6	1.7	81.5	76.5	80.6	1	1	1	4	X	X	17	2	1
4/15	00.0°	140.0°W	1800	97	14	14	02	0	1010.8	2	2.0	81.8	75.9	80.4	1	1	1	4	0	0	19	2	2
4/16	00.0°	140.0°W	0000	97	11	15	03	0	1007.5	7	2.7	81.5	75.5	81.0	3	2	8	4	0	9	17	2	2
4/16	00.0°	140.0°W	1200	97	09	12	00	0	1008.5	7	1.7	80.0	75.8	80.3	2	2	8	4	X	X	11	2	2
4/16	00.0°	140.0°W	1800	97	10	12	01	1	1011.2	2	2.7	82.1	77.1	80.4	3	2	1	4	0	1	11	2	2
4/17	00.0°	140.0°W	0000	97	10	10	01	0	1007.8	7	2.0	81.8	76.0	81.2	2	2	1	4	0	1	10	2	2
4/17	00.0°	140.0°W	0600	97	10	10	00	0	1011.2	2	2.0	80.5	76.3	80.6	2	X	X	X	X	X	10	2	2
4/17	00.0°	140.0°W	1200	97	12	10	00	0	1009.1	7	2.0	81.5	76.5	80.4	2	2	1	4	X	X	13	2	2
4/17	00.0°	140.0°W	1800	97	12	12	02	1	1012.9	1	3.4	81.2	76.6	80.3	7	6	4	4	0	1	13	2	2
4/18	00.0°	140.0°W	0000	97	13	10	03	2	1009.1	7	2.7	81.8	76.7	81.3	7	6	4	5	0	0	14	2	2
4/18	00.0°	140.0°W	0600	97	13	08	00	1	1010.8	2	2.0	80.4	76.7	80.9	2	X	X	X	X	X	14	2	2
4/18	00.4°N	140.0°W	1200	97	12	07	03	1	1009.8	7	1.7	81.5	77.4	80.6	8	X	X	X	X	X	13	2	2
4/18	00.9°N	140.0°W	1800	97	14	10	01	2	1012.5	0	2.4	81.0	76.8	81.2	6	6	8	4	0	0	13	2	2
4/19	01.9°N	140.0°W	0000	97	15	09	01	1	1008.8	7	2.7	83.0	77.1	83.6	3	2	2	4	6	0	14	2	1
4/19	02.0°N	140.0°W	0600	97	10	10	00	8	1011.9	2	2.0	82.0	77.0	83.0	4	X	X	X	X	X	13	2	1
4/19	02.9°N	140.0°W	1200	97	08	10	03	1	1009.5	7	2.0	82.0	77.8	83.1	4	3	2	4	X	X	13	2	1
4/19	03.4°N	140.0°W	1800	97	06	10	15	8	1012.5	2	2.0	82.3	77.1	82.9	7	5	4	4	3	0	07	2	1
4/20	02.6°N	139.9°W	0000	97	13	03	15	8	1007.8	7	2.7	84.0	77.5	85.2	6	4	8	4	4	1	09	2	1
4/20	02.0°N	140.0°W	0600	97	11	06	01	8	1010.2	2	2.0	82.5	77.5	83.5	3	2	8	4	X	X	13	2	1
4/20	02.0°N	140.0°W	1200	97	11	12	01	0	1009.1	6	1.7	82.5	77.8	83.0	1	1	1	4	X	X	13	2	1
4/20	02.0°N	140.0°W	1800	97	18	06	15	1	1012.5	2	2.9	83.8	78.1	82.8	7	5	2	4	3	0	17	2	1
4/21	01.4°N	140.0°W	0000	97	14	12	01	1	1009.1	7	2.7	82.7	77.0	82.5	4	3	1	4	0	1	14	2	1
4/21	00.9°N	140.0°W	0600	97	14	08	01	1	1012.5	2	2.4	81.5	78.0	82.0	1	1	1	4	0	0	14	2	1

Table 9.--Weather observations (USWB 1210-F), *Hugh M. Smith* cruise 45 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
4/21	00.8°N	140.0°W	1200	97	12	12	01	0	1010.5	7	2.0	81.1	77.1	81.4	2	2	1	4	X	X	14	2	1
4/21	00.3°N	139.9°W	1800	97	12	13	01	1	1013.2	2	2.7	82.0	77.3	80.9	4	4	2	4	0	0	14	2	1
4/22	00.5°S	140.0°W	0000	97	13	12	02	0	1009.8	7	1.7	82.0	77.6	81.8	1	1	1	4	0	0	14	2	1
4/22	01.0°S	140.0°W	0600	97	14	12	02	0	1012.5	2	2.7	81.5	76.6	81.5	1	1	1	4	0	0	14	2	1
4/22	01.5°S	140.1°W	1200	97	12	10	02	0	1010.2	7	2.4	81.5	76.5	81.6	1	1	1	4	0	0	14	2	1
4/22	02.1°S	140.2°W	1800	97	11	06	01	0	1012.2	1	1.0	83.6	77.1	82.3	1	1	1	4	0	1	14	2	1
4/23	02.5°S	140.0°W	0000	97	07	03	15	8	1008.5	7	2.0	83.5	77.8	84.1	3	1	3	4	0	8	14	2	1
4/23	03.1°S	140.0°W	0600	97	06	10	02	8	1010.5	2	1.4	82.2	77.9	82.6	2	2	1	4	0	0	12	2	1
4/23	03.2°S	139.9°W	1200	97	03	12	13	0	1008.5	8	1.7	81.8	78.0	82.4	2	1	3	4	X	X	12	2	1
4/23	02.5°S	140.0°W	1800	97	03	08	03	1	1011.2	2	2.0	83.0	77.3	82.2	5	4	4	4	0	1	08	2	1
4/24	02.1°S	140.3°W	0000	97	06	06	02	1	1007.8	7	2.4	84.8	77.0	83.8	2	1	3	4	6	1	16	2	1
4/24	01.5°S	140.0°W	0600	97	06	06	02	8	1009.8	2	1.4	82.9	77.1	82.3	1	1	1	4	0	0	16	2	1
4/24	01.0°S	140.0°W	1200	97	15	06	02	0	1007.5	7	1.4	82.0	77.1	82.0	1	1	X	X	X	X	14	2	1
4/24	00.5°S	140.0°W	1800	97	10	08	02	0	1009.5	2	2.0	82.8	77.8	81.2	3	2	1	4	0	1	11	2	1
4/25	00.0°	140.0°W	0000	97	12	12	02	0	1007.1	7	1.7	83.0	76.6	81.5	1	1	1	4	0	0	14	2	1
4/25	00.0°	140.0°W	0600	97	11	12	03	0	1009.1	2	2.0	81.5	76.7	81.2	2	2	1	4	0	0	14	2	1
4/25	00.1°N	140.1°W	1200	97	09	10	02	0	1007.1	7	1.7	81.5	76.5	81.0	1	1	1	4	X	X	12	2	1
4/25	00.1°N	140.1°W	1800	97	10	16	03	0	1009.8	2	2.0	82.3	76.2	81.0	2	2	1	4	0	0	11	2	1
4/26	00.2°N	140.2°W	0000	97	10	12	02	0	1006.1	7	2.7	82.5	77.0	81.5	1	1	1	4	0	0	11	2	1
4/26	00.2°N	140.2°W	0600	97	09	10	01	0	1009.8	2	2.0	81.2	77.2	81.0	1	1	1	4	0	0	13	2	1
4/26	00.0°	140.0°W	1200	97	09	12	02	0	1007.1	6	1.4	81.0	77.5	81.0	1	1	1	4	X	X	13	2	1
4/26	00.0°	140.0°W	1800	97	11	12	02	0	1009.8	2	1.7	82.7	78.0	81.0	1	1	1	4	0	0	12	2	1
4/27	00.0°	140.0°W	0000	97	11	08	15	8	1007.1	7	2.0	82.5	78.0	81.5	2	1	3	4	6	0	12	2	1
4/27	00.0°	140.0°W	0600	97	08	08	02	8	1009.8	2	2.0	80.0	76.4	81.0	2	2	4	4	0	0	10	2	1
4/27	00.0°	140.1°W	1200	97	11	10	02	1	1008.5	7	1.7	81.5	76.8	81.0	7	7	4	4	X	X	11	2	1
4/27	00.1°N	140.1°W	1800	97	13	12	02	8	1010.5	2	1.7	80.1	76.8	80.9	4	3	4	3	0	1	14	2	1
4/28	00.0°	140.0°W	0000	97	10	14	81	1	1007.8	7	2.0	82.0	78.0	81.3	8	8	4	3	X	X	14	2	1
4/28	00.7°S	140.6°W	0600	97	12	09	03	2	1009.8	1	2.0	81.1	77.0	81.2	7	7	4	4	0	0	12	2	1
4/28	01.7°S	141.2°W	1200	97	13	06	01	1	1007.8	7	1.9	81.5	77.5	82.0	1	1	1	4	X	X	12	2	1
4/28	02.5°S	141.7°W	1800	97	14	12	03	1	1009.5	2	2.0	83.2	77.9	83.1	3	3	1	4	0	0	13	2	1
4/29	03.4°S	142.3°W	0000	93	15	16	02	0	1007.1	7	2.7	82.9	78.0	83.1	3	1	3	4	0	0	15	2	2
4/29	04.3°S	142.8°W	0600	97	13	18	03	1	1008.8	2	2.7	82.8	78.5	82.9	5	5	3	4	0	0	15	2	2
4/29	05.1°S	143.3°W	1200	97	14	14	02	1	1008.1	7	1.0	83.0	78.0	83.2	2	2	1	4	0	0	XX	2	2
4/29	06.0°S	143.6°W	1800	97	10	16	15	1	1009.8	2	1.4	83.0	74.9	83.8	5	3	2	4	6	1	11	2	2
4/30	06.8°S	144.3°W	0000	97	12	18	15	1	1007.1	7	2.0	84.5	78.0	84.2	2	2	3	4	0	0	14	2	2
4/30	07.6°S	144.7°W	0600	97	10	20	01	0	1009.8	2	2.7	84.1	77.0	84.6	1	1	1	3	0	0	15	2	2
4/30	08.8°S	145.2°W	1300	97	10	16	80	1	1008.5	6	1.4	84.0	78.0	84.6	7	4	9	3	X	X	14	2	2
4/30	09.5°S	145.5°W	1800	97	11	18	01	1	1011.2	2	1.7	85.0	78.0	84.8	2	1	2	4	0	6	11	2	2
5/1	10.3°S	146.0°W	0000	97	10	14	02	0	1007.8	7	1.7	84.0	78.1	84.6	1	1	2	4	0	0	12	2	2
5/1	11.2°S	146.3°W	0600	97	10	14	02	0	1009.8	2	2.0	84.0	78.0	84.3	1	1	1	4	X	X	12	2	2
5/1	12.1°S	146.7°W	1200	97	11	14	02	0	1009.8	7	1.4	83.2	76.5	84.0	1	1	1	4	0	0	13	2	2
5/1	12.9°S	147.3°W	1800	97	09	14	02	0	1011.2	2	2.0	83.5	78.5	83.9	1	1	3	4	0	0	12	2	2
5/2	13.5°S	148.0°W	0000	97	12	16	02	0	1009.5	7	2.0	84.1	78.0	84.0	2	2	3	4	0	0	13	2	2
5/2	14.3°S	148.7°W	0600	97	12	12	02	0	1009.8	3	1.7	83.5	77.5	84.2	1	1	1	4	0	0	09	2	2
5/2	15.3°S	149.1°W	1200	97	14	14	02	0	1010.2	7	1.4	82.6	76.8	83.7	1	1	1	4	0	0	10	2	2
5/2	16.5°S	149.2°W	1800	97	09	14	02	0	1011.9	2	2.0	83.5	77.6	83.8	1	1	3	4	0	0	06	2	1
5/3	17.1°S	149.5°W	0000	97	10	16	02	0	1010.2	7	1.7	83.0	76.8	83.9	3	2	3	4	0	1	09	2	1
5/7	17.6°S	149.0°W	1800	97	04	23	02	5	1009.5	0	0.0	79.4	75.6	82.8	8	8	7	4	X	X	04	2	3
5/8	17.0°S	148.4°W	0000	97	01	18	02	2	1007.5	6	1.4	82.5	74.9	83.1	7	7	7	4	0	0	01	2	3
5/8	16.3°S	147.9°W	0600	97	01	23	80	2	1010.8	2	2.0	83.0	76.3	83.1	8	8	5	4	X	X	01	2	3

Table 9.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 45 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
5/8	16.0°S	147.6°W	1200	97	02	16	01	8	1009.5	8	1.4	82.5	74.8	83.1	7	1	1	4	4	6	01	2	1
5/8	15.7°S	147.4°W	1800	97	02	18	01	2	1010.5	1	1.7	83.2	76.8	83.4	6	2	2	4	3	0	02	2	2
5/9	15.0°S	146.8°W	0000	97	02	12	01	1	1008.8	7	1.4	83.8	75.5	83.7	2	2	0	X	3	0	03	2	2
5/9	14.2°S	146.3°W	0600	98	05	12	01	1	1009.8	2	1.4	83.0	76.3	83.3	2	1	1	4	8	0	04	2	2
5/9	13.7°S	145.6°W	1200	97	06	15	02	0	1008.5	7	1.0	83.0	76.3	83.6	2	1	1	4	6	0	05	2	2
5/9	13.1°S	144.9°W	1800	97	05	14	02	0	1011.2	1	2.0	84.5	77.2	83.2	1	1	2	4	0	0	06	2	2
5/10	12.5°S	144.2°W	0000	97	07	10	02	0	1008.5	7	2.0	83.9	76.0	84.0	1	1	2	4	0	0	06	2	2
5/10	11.9°S	143.5°W	0600	98	10	14	01	1	1010.2	2	1.4	83.3	78.2	84.5	1	1	1	4	0	0	06	3	2
5/10	11.4°S	142.9°W	1200	97	11	14	00	0	1009.1	6	1.0	82.5	77.0	83.0	1	1	1	4	0	0	09	2	2
5/10	10.8°S	142.3°W	1800	97	10	18	02	0	1011.5	3	2.4	83.7	75.2	83.2	1	1	2	4	0	0	10	2	3
5/11	10.3°S	141.7°W	0000	97	11	18	03	0	1007.1	7	2.7	84.5	76.2	84.0	2	2	1	4	0	0	10	2	3
5/11	09.8°S	141.0°W	0600	98	11	17	01	1	1009.1	2	1.7	83.0	78.0	83.8	2	2	2	4	0	0	10	3	3
5/11	09.3°S	140.3°W	1200	97	07	12	02	0	1007.5	6	1.0	80.0	76.8	83.0	1	1	1	4	0	0	08	3	3
5/15	09.2°S	139.3°W	1800	97	09	12	03	0	1011.9	2	2.0	82.9	76.6	83.1	2	2	1	4	0	0	09	3	2
5/16	09.1°S	138.7°W	0000	97	13	14	02	0	1007.5	6	1.4	82.8	77.0	83.1	2	1	1	4	0	5	10	3	2
5/16	09.1°S	138.1°W	0600	98	11	16	02	0	1010.2	2	1.5	82.2	76.0	82.6	1	1	1	4	0	0	12	3	2
5/16	09.2°S	137.4°W	1200	97	10	10	02	0	1008.8	7	0.7	81.6	75.7	82.4	1	1	1	4	0	0	10	2	2
5/16	09.2°S	136.8°W	1800	97	11	13	02	0	1011.9	1	2.0	82.2	76.2	82.8	2	1	2	4	1	0	11	2	2
5/17	09.2°S	136.1°W	0000	98	10	12	03	0	1009.5	7	2.0	82,5	75.2	82.7	3	1	1	5	8	8	09	3	3
5/17	09.2°S	136.1°W	0600	98	09	14	02	0	1011.5	2	2.0	82.1	75.0	82.5	2	1	1	X	X	X	09	3	2
5/17	09.2°S	137.0°W	1200	98	08	10	02	0	1010.5	6	0.9	81.2	75.5	82.6	1	1	1	4	0	0	09	3	2
5/17	09.2°S	137.7°W	1800	97	08	14	03	0	1012.2	1	1.4	82.9	74.9	82.8	3	1	1	4	0	5	09	2	1
5/18	09.2°S	138.5°W	0000	98	08	08	02	0	1008.8	7	2.7	XXX	76.8	83.2	2	2	1	5	0	2	08	2	2
5/18	09.2°S	139.1°W	0600	99	13	12	01	0	1010.8	2	2.0	82.2	75.5	82.8	1	1	1	4	0	0	10	2	1
5/19	09.2°S	140.1°W	1800	99	10	18	02	0	1013.2	2	1.4	82.9	75.3	83.1	2	2	4	4	0	0	08	1	1
5/20	09.2°S	140.7°W	0000	98	10	10	02	0	1009.8	7	2.0	83.8	76.2	83.6	2	2	2	5	0	1	10	2	2
5/20	09.2°S	141.3°W	0600	98	12	17	02	0	1011.5	2	1.4	83.2	77.0	83.2	2	2	X	X	X	X	08	2	2
5/20	09.2°S	142.0°W	1200	98	10	14	02	0	1010.5	7	1.4	82.4	75.3	83.8	2	2	1	4	0	0	10	2	2
5/20	09.3°S	142.6°W	1800	97	07	12	01	1	1012.9	1	1.0	83.8	76.3	84.0	1	1	2	4	4	0	10	2	2
5/21	09.2°S	143.2°W	0000	98	07	11	02	0	1009.1	7	2.4	XXX	77.3	84.3	1	1	2	5	0	9	07	2	2
5/21	09.2°S	143.1°W	0600	97	10	12	03	0	1010.5	2	1.7	83.6	77.2	84.0	3	3	X	X	X	X	09	2	2
5/21	09.2°S	142.4°W	1200	97	12	14	64	1	1009.5	7	1.4	81.0	76.0	83.0	4	4	X	X	X	X	09	2	2
5/21	09.2°S	141.8°W	1800	97	08	10	01	0	1010.8	2	1.4	83.3	75.8	83.8	1	1	2	4	0	0	09	2	2
5/22	09.2°S	141.1°W	0000	97	10	12	91	8	1007.5	7	2.4	82.8	77.7	83.5	6	6	9	4	0	0	10	2	2
5/22	09.2°S	140.6°W	0600	98	10	20	81	8	1008.1	3	1.7	80.3	76.5	82.8	4	4	5	4	0	0	09	2	2
5/22	08.9°S	140.2°W	1800	98	12	18	03	0	1009.1	1	1.4	83.1	75.8	83.1	2	1	2	4	0	5	13	2	2
5/23	08.8°S	139.7°W	1800	98	09	12	03	1	1010.8	1	1.4	82.7	74.3	82.8	5	2	2	4	0	2	09	2	2
5/24	08.1°S	139.7°W	0000	98	09	14	02	1	1007.8	7	1.7	82.7	75.5	83.2	3	1	1	5	0	8	08	2	3
5/24	07.6°S	139.7°W	0600	98	06	12	01	1	1009.1	2	2.2	81.7	75.3	82.7	1	1	1	4	0	0	08	2	2
5/24	06.9°S	139.7°W	1200	98	07	11	02	0	1008.8	6	0.7	80.5	75.5	82.3	1	1	X	X	X	X	08	2	2
5/24	06.3°S	139.6°W	1800	97	09	05	01	1	1010.8	2	1.4	83.3	75.3	82.4	4	1	1	4	0	6	08	3	1
5/25	05.7°S	139.6°W	0000	97	07	06	02	0	1007.5	7	2.0	82.3	75.3	83.8	1	1	2	5	0	0	07	3	2
5/25	05.6°S	139.6°W	0600	97	10	07	02	0	1009.8	2	2.0	81.7	74.2	82.7	1	1	2	4	0	0	10	3	1
5/25	06.4°S	139.6°W	1200	97	00	00	03	0	1009.1	7	0.7	81.0	74.8	82.7	2	1	1	4	0	1	10	3	0
5/25	07.1°S	139.7°W	1800	96	08	15	15	6	1012.2	1	2.0	79.8	75.2	82.4	7	7	7	4	0	0	09	3	2
5/26	07.7°S	139.7°W	0000	97	23	07	15	8	1008.8	7	2.4	80.9	75.3	83.2	7	7	9	8	0	0	10	3	2
5/26	08.4°S	139.7°W	0600	97	12	07	02	1	1011.2	1	2.0	81.6	74.1	82.9	2	2	2	X	X	X	09	3	1
5/27	09.6°S	139.7°W	1800	97	08	22	03	0	1012.2	2	1.7	81.9	73.3	82.9	2	1	2	4	0	2	09	2	2
5/28	10.3°S	139.7°W	0000	97	05	13	03	1	1009.1	7	2.0	82.2	74.8	83.2	5	5	4	4	0	0	07	2	2
5/28	10.9°S	139.6°W	0600	97	05	16	01	1	1011.2	2	1.4	82.0	75.8	82.7	1	1	1	4	0	0	07	2	2

Table 9.--Weather observations (USWB 1210-F), Hugh M. Smith cruise 45 (cont'd)

Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Wind		Weather		Pressure			Temperature			Clouds						Waves		
					Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
5/28	11.5°S	139.7°W	1200	97	06	12	02	0	1010.5	7	0.7	81.7	76.8	82.8	1	1	1	4	0	0	05	3	1
5/28	12.1°S	139.7°W	1800	97	02	13	02	0	1012.9	2	2.4	82.8	76.2	82.7	2	2	2	4	0	0	01	2	2
5/29	12.6°S	139.7°W	0000	98	02	16	02	1	1009.8	7	2.4	83.8	77.2	82.9	6	2	2	5	0	4	02	2	2
5/29	12.7°S	139.7°W	0600	98	35	10	02	1	1013.2	1	2.0	82.5	76.0	82.5	5	4	2	6	X	X	02	2	2
5/29	12.0°S	139.7°W	1200	98	02	15	02	2	1011.2	7	1.4	81.2	75.6	82.8	4	4	4	4	0	0	02	2	2
5/29	11.3°S	139.7°W	1800	97	02	09	02	1	1013.2	1	1.7	82.6	75.7	82.8	2	2	2	4	0	0	02	2	2
5/30	10.7°S	139.7°W	0000	98	01	08	02	0	1009.5	7	2.7	82.8	74.8	83.4	3	2	2	5	0	1	02	2	2
5/30	10.1°S	139.6°W	0600	98	02	03	02	0	1011.9	3	1.4	82.2	74.6	83.3	3	2	2	5	0	5	02	2	1
5/30	09.4°S	139.6°W	1200	98	05	11	02	0	1011.2	7	0.7	81.0	75.2	82.6	4	4	2	5	0	0	02	2	1
6/1	08.8°S	140.5°W	1800	98	03	19	02	2	1011.9	2	2.0	82.6	75.2	83.1	6	6	5	4	0	0	06	2	2
6/2	08.2°S	140.7°W	0000	98	05	12	01	1	1008.5	7	2.4	82.6	73.2	83.5	1	1	2	4	0	1	07	2	2
6/2	07.9°S	140.7°W	0600	98	06	13	02	0	1010.8	2	2.4	81.7	74.3	82.9	1	1	1	4	0	0	06	2	2
6/2	07.9°S	140.7°W	1200	98	05	10	16	0	1009.8	8	1.4	81.5	74.8	83.3	1	1	9	4	0	0	06	2	0
6/2	07.9°S	140.3°W	1800	98	05	16	02	0	1011.5	3	2.0	82.8	73.8	83.0	1	1	2	4	0	0	05	2	1
6/3	07.9°S	139.9°W	0000	98	08	10	01	0	1008.5	7	2.0	83.0	75.3	83.3	1	1	1	5	0	0	08	2	1
6/3	08.1°S	139.6°W	0600	96	08	14	83	1	1010.5	2	1.7	80.5	75.5	83.0	8	8	7	5	X	X	08	2	1
6/3	08.1°S	139.6°W	1200	97	09	17	01	1	1009.5	8	1.0	81.3	73.8	82.8	2	2	2	4	0	0	09	2	2
6/3	08.4°S	139.4°W	1800	97	08	16	01	0	1012.2	2	2.0	83.1	74.0	82.8	1	1	2	4	0	0	09	2	2
6/4	08.9°S	139.3°W	0000	98	09	11	02	0	1009.1	6	2.0	82.3	75.3	82.8	2	2	2	5	0	0	09	2	2
6/5	08.9°S	139.9°W	1200	98	08	20	01	1	1010.5	8	1.4	81.0	75.0	82.6	2	2	2	4	0	0	08	2	2
6/5	09.3°S	139.2°W	1800	98	10	22	01	1	1011.5	2	1.4	82.2	75.8	82.6	1	1	2	4	0	0	10	2	3
6/6	09.6°S	138.8°W	0000	98	09	18	02	0	1008.5	7	2.4	83.0	76.8	82.8	1	1	2	5	0	0	09	3	3
6/6	09.9°S	139.0°W	1800	98	10	14	00	0	1012.2	2	1.4	82.3	75.8	82.8	3	2	2	4	0	5	10	2	3
6/7	09.7°S	139.1°W	0000	98	07	20	02	1	1008.1	7	2.0	83.5	76.0	82.8	5	3	2	5	0	1	06	2	3
6/7	10.2°S	138.8°W	1800	98	10	17	15	1	1013.2	2	2.4	82.3	75.3	82.8	3	3	2	5	0	0	09	3	3
6/8	10.6°S	138.7°W	0000	98	08	09	03	1	1010.5	7	2.0	82.9	75.8	82.9	2	2	2	5	0	0	08	3	3
6/8	Omoa, Fatu Hiva		0600	97	11	08	02	0	1012.2	2	1.4	75.9	72.8	82.7	1	1	1	5	0	0	27	2	0
6/8	10.1°S	139.1°W	1800	98	07	09	02	0	1012.9	2	1.4	81.9	74.6	82.9	2	1	2	5	0	5	09	2	0
6/9	09.6°S	139.8°W	0000	98	09	12	02	0	1009.8	6	2.0	82.7	75.3	83.0	1	1	2	5	0	5	09	2	1
6/9	09.6°S	139.8°W	0600	98	09	12	02	0	1012.5	1	1.4	82.2	75.2	82.8	1	1	2	5	X	X	09	2	1
6/9	09.6°S	139.8°W	1200	98	07	14	02	0	1011.9	6	0.7	82.1	76.0	82.5	2	1	2	5	X	X	09	2	2
6/9	09.6°S	139.8°W	1800	98	08	12	15	1	1014.6	2	1.7	82.6	77.0	82.7	2	2	9	5	0	0	08	2	2
6/10	09.5°S	140.1°W	0000	98	05	10	01	8	1011.9	7	2.0	82.7	76.8	83.2	3	2	9	5	5	0	07	2	2
6/10	09.2°S	140.1°W	1900	98	11	16	01	0	1012.9	1	0.7	82.9	77.5	82.8	2	1	2	5	5	0	11	2	2
6/13	08.5°S	139.5°W	0600	98	11	13	01	0	1012.5	2	2.4	81.6	75.4	82.3	1	1	1	4	0	0	09	3	3
6/13	07.9°S	139.0°W	1200	98	09	14	02	0	1011.9	6	1.0	81.0	76.0	82.3	1	1	1	4	0	0	12	3	2
6/13	07.0°S	139.1°W	1800	98	10	11	02	0	1013.5	2	1.7	82.7	76.1	82.3	3	2	1	4	0	1	12	2	1
6/14	06.1°S	139.2°W	0000	97	09	10	15	8	1011.2	7	1.7	82.1	77.4	83.1	6	5	9	4	6	0	10	4	1
6/14	05.3°S	139.2°W	0600	98	11	10	01	8	1012.9	2	2.0	81.3	77.0	82.3	1	1	X	X	X	X	12	2	1
6/14	04.3°S	139.4°W	1200	98	11	08	00	0	1011.2	7	1.4	80.2	76.0	81.9	1	1	1	4	0	0	12	2	1
6/14	03.4°S	139.5°W	1800	97	12	14	03	0	1012.9	1	1.7	82.4	77.0	82.0	2	2	2	4	0	3	12	2	2
6/15	02.5°S	139.6°W	0000	98	08	10	01	1	1010.5	6	2.0	82.0	77.0	82.1	6	6	2	6	0	0	11	2	1
6/15	01.7°S	139.7°W	0600	98	10	12	00	1	1011.5	1	1.7	80.8	76.1	80.7	X	X	X	X	X	X	11	2	1
6/15	00.8°S	139.7°W	1200	97	09	08	02	0	1010.2	8	1.5	79.0	75.8	80.4	1	1	1	4	0	0	10	2	0
6/15	00.0°	140.0°W	1800	98	11	10	02	0	1011.9	1	1.0	81.2	76.0	81.1	2	2	2	5	0	0	08	2	0
6/16	00.5°N	140.5°W	0000	98	12	08	02	1	1008.8	7	2.0	82.0	76.0	83.0	6	6	2	4	0	0	12	2	0
6/16	01.1°N	141.1°W	0600	97	11	12	02	1	1009.1	2	1.7	81.9	76.2	82.9	1	1	1	4	0	0	11	3	1
6/16	01.9°N	141.7°W	1200	98	10	11	02	0	1008.5	7	2.0	81.6	75.5	82.8	1	1	2	X	X	X	11	2	1
6/16	02.6°N	142.2°W	1800	98	12	11	02	0	1010.2	2	1.4	82.4	75.0	82.8	3	3	2	0	0	0	11	2	1
6/17	03.4°N	142.6°W	0000	97	12	10	01	0	1008.1	7	1.7	83.2	75.8	83.4	1	1	1	4	0	1	12	2	1

Table 9.--Weather observations (USWB 1210-F), *Hugh M. Smith* cruise 45 (cont'd)

					Wind		Weather		Pressure			Temperature			Clouds						Waves		
Date, 1958	Latitude	Longitude	Time, GCT	Visibility	Direction	Speed, kt.	Present	Past	Bar. corr., mb.	Characteristic	Amt. change	Dry bulb, °F.	Wet bulb, °F.	Sea water, °F.	Total amount	Amount low	Type low	Height low	Type middle	Type high	Direction	Period	Height
6/17	04.1°N	143.0°W	0600	98	13	12	02	0	1009.8	1	2.0	82.1	76.2	83.0	1	1	2	6	X	X	11	2	1
6/17	04.7°N	143.4°W	1200	98	13	13	03	0	1008.8	8	1.4	82.0	75.5	83.2	2	2	2	4	0	0	12	3	2
6/17	05.4°N	143.8°W	1800	97	09	12	81	8	1011.2	2	2.0	78.0	76.5	82.9	8	8	9	4	X	X	08	3	2
6/18	06.1°N	144.2°W	0000	98	29	03	80	8	1009.5	6	1.4	80.2	77.0	83.0	8	8	9	5	X	X	09	2	1
6/18	06.8°N	144.7°W	0600	98	12	11	00	8	1011.2	2	1.7	81.7	77.0	83.5	X	X	X	X	X	X	09	2	1
6/18	07.4°N	145.1°W	1200	97	09	15	01	8	1010.2	8	1.7	81.6	77.5	83.2	2	2	2	4	0	0	08	2	2
6/18	07.9°N	145.6°W	1800	97	08	09	15	8	1012.2	2	1.4	82.8	77.8	82.8	2	2	3	4	3	2	06	2	2
6/19	08.6°N	146.2°W	0000	97	06	09	01	0	1010.8	7	1.7	82.9	72.1	83.2	3	3	2	4	0	0	05	2	2
6/19	09.2°N	146.7°W	0600	97	04	14	02	0	1011.5	2	1.4	81.6	76.8	82.7	2	2	2	4	0	0	04	2	2
6/19	09.9°N	147.2°W	1200	98	03	14	50	1	1011.9	7	1.0	80.1	76.0	82.0	6	6	2	4	X	X	03	2	2
6/19	10.6°N	147.9°W	1800	97	05	16	25	8	1012.2	3	1.5	80.6	77.6	82.0	7	5	9	4	6	0	03	2	2
6/20	11.3°N	148.5°W	0000	97	05	21	16	8	1011.5	8	0.7	81.4	77.8	82.0	6	4	2	4	7	5	04	2	4
6/20	12.0°N	149.1°W	0600	98	05	22	01	8	1012.9	2	2.0	80.0	77.0	80.5	4	4	2	5	X	X	05	2	3
6/20	12.6°N	149.5°W	1200	97	05	16	00	X	1013.2	7	1.4	77.7	76.0	79.2	4	X	X	X	X	X	05	2	3
6/20	13.3°N	150.1°W	1800	96	06	21	60	5	1014.2	1	1.4	78.3	75.3	79.7	8	8	7	5	X	X	05	2	3
6/21	14.0°N	150.6°W	0000	98	05	22	02	2	1013.9	6	1.4	78.3	74.0	79.1	5	3	4	5	5	9	06	2	3
6/21	14.7°N	151.1°W	0600	97	07	20	03	2	1014.9	2	1.4	77.9	72.5	78.0	6	6	4	4	X	X	05	2	2
6/21	15.3°N	151.6°W	1200	97	07	18	01	1	1014.6	8	0.7	77.1	72.0	77.8	2	2	2	4	0	0	05	2	2
6/21	16.0°N	152.2°W	1800	96	04	16	20	1	1016.6	1	2.0	77.0	71.6	77.1	7	7	7	4	0	0	05	2	2
6/22	16.7°N	152.8°W	0000	97	05	15	02	1	1015.2	7	1.4	78.9	71.1	77.1	2	2	2	4	0	0	03	2	2
6/22	17.2°N	153.7°W	0600	97	05	16	02	0	1015.2	3	1.0	76.2	69.7	77.1	2	2	2	5	0	0	06	2	2
6/22	17.8°N	154.3°W	1200	97	05	09	50	0	1015.2	6	1.4	76.3	71.0	76.9	4	3	7	3	X	X	05	2	2
6/22	18.4°N	155.1°W	1800	98	06	13	01	0	1016.3	2	1.4	77.4	71.3	77.1	1	1	4	4	0	0	04	2	2
6/23	19.0°N	155.8°W	0000	98	12	18	03	0	1014.9	8	0.9	77.9	71.6	77.7	3	3	3	5	0	0	09	2	1
6/23	19.6°N	156.4°W	0600	97	23	13	03	8	1014.2	2	1.0	77.2	71.0	77.9	7	3	2	6	6	0	28	2	1
6/23	20.2°N	156.9°W	1200	97	07	17	00	1	1014.2	7	0.7	76.2	71.9	77.6	3	3	2	4	0	0	06	2	1
6/23	21.1°N	157.6°W	1800	98	05	14	15	8	1014.9	2	1.5	76.8	69.8	77.8	6	4	9	5	6	0	08	2	2

Table 10.--Surface salinity and temperature observations taken at locations other than bathythermograph lowerings, *Charles H. Gilbert* cruises 35 and 38, and *Hugh M. Smith* cruises 43 and 45

Vessel	Date, GCT	Time, GCT	Position		Salinity, ‰	Temp., °F.
			Latitude	Longitude		
CHG-35	10/13/57	1800	08°56'S	140°05'W	35.75	82.2
"	10/23/57	1520	"	"	35.81	81.6
"	11/29/57	2300	09°48'S	139°02'W	35.64	82.2
"	12/3/57	0105	08°56'S	140°05'W	35.73	83.0
HMS-43	1/15/58	1846	08°56'S	140°05'W	35.75	85.5
"	1/16/58	1800	08°54'S	140°02'W	34.04	83.4
"	1/17/58	1430	08°50'S	140°02'W	35.71	83.5
"	"	1908	08°58'S	140°10'W	35.52	84.4
"	"	1956	"	"	32.12	83.0
"	1/21/58	0554	08°55'S	139°32'W	35.73	83.1
"	1/22/58	0552	09°48'S	139°02'W	35.75	82.9
"	1/22/58	1526	"	"	35.70	82.0
"	1/25/58	1550	09°20'S	140°04'W	35.81	83.2
"	"	2100	08°58'S	140°10'W	23.48	83.6
"	1/26/58	1556	08°56'S	140°05'W	35.82	82.8
"	1/27/58	1530	08°54'S	140°02'W	29.87	83.3
"	"	?	"	"	35.52	83.3
"	"	?	"	"	27.34	83.0
"	"	1925	08°50'S	140°02'W	35.70	83.8
"	"	2105	"	140°04'W	35.12	84.2
"	2/3/58	1554	08°56'S	140°05'W	35.75	83.0
"	2/4/58	0043	08°58'S	140°10'W	32.54	80.8
"	"	1520	08°54'S	140°00'W	34.92	82.7
"	"	1700	"	140°02'W	8.55	77.2
"	"	2212	"	"	25.05	87.0
"	2/5/58	0150	08°56'S	140°05'W	35.68	84.6
"	2/8/58	1800	"	139°32'W	33.53	82.2
"	"	2035	"	139°35'W	25.03	87.0
"	2/12/58	1650	08°50'S	140°02'W	35.77	81.5
"	2/13/58	0045	08°56'S	140°05'W	35.75	85.8
"	2/14/58	2014	08°58'S	140°10'W	33.53	85.3
"	2/15/58	0127	08°56'S	140°05'W	35.73	85.3
CHG-38	2/26/58	1540	08°56'S	140°05'W	35.89	84.1
"	"	2315	08°58'S	140°09'W	-	86.5
"	3/3/58	1728	09°54'S	139°05'W	35.80	84.0
"	3/9/58	0212	08°56'S	140°05'W	35.95	84.4
"	"	1613	"	"	35.84	83.5
"	3/10/58	0225	08°58'S	140°10'W	34.08	84.4
"	3/24/58	1603	08°56'S	140°05'W	35.96	84.1
"	3/25/58	1605	"	"	35.93	84.0
"	4/2/58	1740	08°58'S	140°10'W	35.59	84.3
"	4/9/58	1805	08°54'S	140°02'W	35.89	84.4
"	4/10/58	1545	08°56'S	140°05'W	35.95	84.4
"	4/15/58	1620	09°59'S	139°06'W	36.05	84.2
"	4/19/58	2300	08°56'S	140°05'W	35.95	86.3
"	4/20/58	0200	08°58'S	140°10'W	33.52	85.6
"	"	1605	08°56'S	140°05'W	35.98	84.8
HMS-45	5/12/58	2215	08°58'S	140°09'W	35.67	84.8
"	5/13/58	1530	08°54'S	140°02'W	32.41	81.5
"	"	2018	08°55'S	140°02'W	35.56	85.5
"	5/18/58	2225	08°58'S	140°09'W	35.52	84.5
"	5/22/58	1910	"	"	35.60	82.5
"	6/6/58	1530	09°48'S	139°02'W	34.74	74.0
"	"	2155	09°46'S	139°08'W	33.96	84.0
"	6/11/58	1840	08°58'S	140°09'W	34.81	82.0
"	"	2240	08°54'S	140°02'W	27.75	82.0

Table 11.--Transparency, water color, and related observations, *Charles H. Gilbert* cruise 35

Date, 1957	Time, LT	Position		Secchi disc, meters	Water color (Forel)	Sea[1]	Wind[2]	Percent sky cover
		Latitude	Longitude					
10/14	1145	08°23'S	140°32'W	27.4	2.0	2	07-15	70-80
10/15	1100	07°47'S	140°02'W	29.3	2.0	2	08-10	60
10/16	1100	08°40'S	139°20'W	30.2	2.0	2	09-12	70-80
10/17	1100	09°32'S	138°52'W	25.6	2.0	2	08-09	70-80
10/18	1110	10°15'S	138°34'W	-	2.0	3	10-18	90
10/19	1110	09°59'S	139°11'W	21.9	2.0	4	11-17	100
10/20	1115	09°30'S	139°56'W	32.9	2.0	2	12-14	20-30
10/24	1100	09°06'S	139°11'W	28.3	2.0	3	09-15	50
10/25	1100	09°18'S	136°22'W	33.8	2.5	2	09-10	20-30
10/26	1100	09°13'S	137°37'W	32.9	2.0	1	09-12	100
10/29	1100	11°20'S	139°25'W	30.2	2.0	3	07-17	100

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[1] Sea state coded according to H. O. Pub. No. 606-c, second edition; 1956.

[2] Wind direction and speed coded according to U. S. Weather Bureau, Circular M.

Table 12.--Transparency, water color, and related observations, *Hugh M. Smith* cruise 43

Date, 1958	Time, LT	Position		Secchi disc, meters	Water color (Forel)	Sea[1]	Wind[2]	Percent sky cover
		Latitude	Longitude					
1/18	1230	08°27'S	140°41'W	17.4	3	3	NE-18	60
1/19	1231	07°52'S	140°10'W	17.4	3	4	NE-14	40
1/20	1227	08°52'S	139°12'W	12.8	3	4	NE-15	60
1/21	1300	09°29'S	138°52'W	13.7	3	3	NE-14	20
1/22	1227	10°08'S	138°47'W	17.4	3	3	NE-12	60
1/23	1229	09°57'S	139°26'W	11.9	3	2	N -11	60
1/24	1200	09°34'S	139°50'W	15.5	3	2	NE-10	40
1/28	1215	09°18'S	137°48'W	14.6	3	3	E -16	70
1/29	1220	09°10'S	136°46'W	26.5	3	2	NE- 8	40
1/30	1231	09°12'S	139°23'W	11.9	3	3	NE-16	80
1/31	1232	11°19'S	139°38'W	14.6	3	3	E -18	40
2/1	1232	12°14'S	139°38'W	17.4	3	3	E -12	30
2/2	1232	09°32'S	139°40'W	18.3	3	3	E -14	70
2/5	1245	09°12'S	140°32'W	18.3	3	3	E -16	20
2/6	1245	09°03'S	142°35'W	17.4	3	3	E -13	30
2/7	1240	09°10'S	141°22'W	18.3	3	4	E -18	10
2/9	1234	08°13'S	139°40'W	17.4	3	3	E -18	50
2/10	1233	05°54'S	139°30'W	27.4	3	3	E -14	10
2/11	1232	07°32'S	139°34'W	18.3	3	2	E -11	30

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[1] Sea state coded according to H. O. Pub. No. 606-c, second edition, 1956.

[2] Wind direction in compass points (true), and speed in knots.

Table 13.--Transparency, water color, and related observations, *Charles H. Gilbert* cruise 38

Date, 1958	Noon position [1]		Secchi disc, meters	Water color (Forel)	Sea [2]	Wind [3]	Percent sky cover
	Latitude	Longitude					
2/27	08°34'S	140°36'W	22.9	3-4	2	NE - 7	30
2/28	07°42'S	140°10'W	25.6	3	3	NW - 6	30
3/1	08°42'S	139°18'W	25.6	3	2	NNW- 7	60
3/2	09°28'S	138°53'W	25.6	3	2	ENE- 11	20
3/3	10°06'S	138°52'W	25.6	3	2	NE - 10	40
3/4	10°02'S	139°06'W	18.3	4	2	NE - 14	20
3/5	09°36'S	139°48'W	27.4	3	2	NE - 7	20
3/6	09°34'S	139°49'W	21.9	4	3	NE - 15	20
3/26	09°10'S	138°58'W	22.9	3	3	E - 9	50
3/27	09°12'S	136°36'W	28.3	4	3	E - 8	50
4/11	08°32'S	140°40'W	26.5	3	2	NE - 9	20
4/12	07°50'S	140°06'W	25.6	3	2	E - 11	40
4/13	08°44'S	139°32'W	21.9	3-4	3	E - 14	20
4/15	10°12'S	138°50'W	19.2	3-4	3	E - 14	70

[1] All observations taken at 1200 LT.

[2] Sea state coded according to H.O. Pub. No. 606-c, second edition, 1956.

[3] Wind direction in compass points (true), and speed in knots.

Table 14.--Transparency, water color, and related observations, *Hugh M. Smith* cruise 45

Date, 1958	Time, LT	Position		Secchi disc, meters	Water color (Forel)	Sea [1]	Wind [2]	Percent sky cover
		Latitude	Longitude					
5/15	1205	09°14'S	138°58'W	31.1	3	2	10-12	20-30
5/16	1210	09°10'S	136°27'W	29.3	2	2	10-12	20-30
5/17	1210	09°16'S	138°03'W	29.3	2	2	09-12	20-30
5/19	1210	09°16'S	140°28'W	25.6	3	2	09-20	20-30
5/20	1210	09°17'S	142°54'W	27.4	2	2	09-14	10
5/21	1210	09°14'S	141°21'W	27.4	2	2	13-15	70-80
5/23	1210	08°24'S	139°40'W	31.1	2	2	08-14	70-80
5/24	1220	05°58'S	139°36'W	32.9	2	1	10-05	20-30
5/25	1215	07°24'S	139°42'W	32.9	2	2	08-05	20-30
5/27	1215	10°00'S	139°40'W	23.7	3	2	08-18	20-30
5/28	1215	12°20'S	139°43'W	31.1	2	2	02-17	50
5/29	1210	10°55'S	139°45'W	32.9	2	2	02-12	40
6/1	1210	08°29'S	140°38'W	29.3	2	2	04-16	20-30
6/2	1210	07°45'S	140°12'W	31.1	2	1	05-14	10
6/3	1220	08°40'S	139°20'W	32.9	2	2	08-14	10
6/5	1300	09°28'S	138°54'W	21.9	2	3	09-16	40
6/7	1210	10°19'S	138°30'W	25.6	2	3	09-18	10
6/8	1210	09°48'S	139°29'W	31.1	2	2	06-14	20-30

[1] Sea state coded according to H.O. Pub. No. 606-c, second edition, 1956.

[2] Wind direction and speed coded according to U. S. Weather Bureau, Circular M.

Table 15.--Zooplankton station data and sample volumes, Charles H. Gilbert cruise 35

Station	Sample	Date, 1957	Time, +10 ZT	Position		Depth, m.	Water strained, m.^{3}	Volume, cc./1000 m.^{3} [1]
				Latitude	Longitude			
1	1	10/4	0001-0032	17°40'N	155°12'W	0-140	1830.6	18
2	1	10/5	0000-0031	14°40'N	153°11'W	"	1707.5	15
3	1	10/6	0000-0030	11°42'N	151°30'W	"	2515.0	18
5	1	10/8	0000-0031	05°53'N	147°52'W	"	2465.6	24
6	1	10/9	0000-0030	03°10'N	146°18'W	"	2369.0	31
7	1	10/9-10	2358-0030	00°17'N	144°32'W	"	2307.2	37
9	1	10/11-12	2357-0027	06°00'S	141°53'W	"	2363.6	17
18	1	10/21	0639-0711	09°34'S	139°50'W	"	2185.1	30
19	1	"	0714-0745	"	"	"	2112.5	39
20	1	"	0935-1005	"	"	"	1927.0	31
21	1	"	1008-1037	"	"	"	1895.9	36
22	1	"	1235-1305	"	"	"	1789.0	41
23	1	"	1306-1334	"	"	"	1860.8	39
24	1	"	1532-1603	"	"	"	2082.5	38
25	1	"	1606-1637	"	"	"	2068.2	47
26	1	"	1833-1905	"	"	"	2331.2	67
27	1	"	1907-1937	"	"	"	1842.2	58
28	1	"	2135-2205	"	"	"	1735.6	79
29	1	"	2206-2238	"	"	0-143	1979.1	69
30	1	10/22	0043-0113	"	"	0-140	2039.6	70
31	1	"	0114-0144	"	"	"	2078.5	62
32	1	"	0331-0359	"	"	"	1733.9	86
33	1	"	0401-0432	"	"	"	2073.1	73
35	1	10/24	2201-2229	09°16'S	137°52'W	0-182	1681.0	20
36	1	"	2233-2301	"	"	0-140	1546.8	20
38	1	10/25	0159-0230	09°22'S	137°30'W	"	1316.0	24
38A	1	"	0232-0301	"	"	"	1487.2	27
38B	1	"	2156-2227	09°14'S	136°20'W	"	1760.4	18
39	1	"	2229-2301	"	"	"	1797.9	19
41	1	10/26	0158-0229	09°14'S	136°34'W	0-173	1750.1	25
42	1	"	0230-0301	"	"	0-140	1694.2	25
44	1	"	2159-2229	09°17'S	139°02'W	"	1486.1	22
45	1	"	2231-2303	"	"	"	1582.7	21
47	1	10/27	0154-0224	09°17'S	139°16'W	"	1558.2	37
48	1	"	0226-0257	"	"	"	1463.9	46
50	1	"	2200-2230	11°03'S	139°33'W	"	1530.1	34
51	1	"	2232-2300	"	"	"	1354.9	34
53	1	10/28	0158-0228	11°22'S	139°27'W	"	1533.9	33
54	1	"	0230-0301	"	"	"	1655.9	40
55	1	"	2200-2231	12°23'S	139°36'W	"	2011.0	38
56	1	"	2232-2300	"	"	"	1722.6	38
58	1	10/29	0158-0227	12°09'S	139°30'W	"	1527.4	37
59	1	"	0229-0258	"	"	"	1453.1	38
60	1	10/30	0200-0228	09°36'S	139°44'W	"	1134.0	41
61	1	"	0229-0300	"	"	"	1336.5	36
62A	1	11/1	2158-2229	07°20'S	139°32'W	"	1663.2	32
63	1	"	2231-2259	"	"	"	1414.5	41
65	1	11/2	0157-0227	07°06'S	139°30'W	"	3365.6	23
66	1	"	0232-0300	"	"	"	1633.8	43
67	1	"	2157-2227	06°04'S	139°50'W	"	1788.8	18
68	1	"	2229-2300	"	"	"	1915.1	30

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[1] All fish, fish eggs, jellies >2 cm. in length, and other organisms >5 cm. in length are not included.

Table 15.--Zooplankton station data and sample volumes, Charles H. Gilbert cruise 35 (cont'd)

Station	Sample	Date, 1957	Time, +10 ZT	Position		Depth, m.	Water strained, $m.^3$	Volume, $cc./1000\ m.^3$ [1]
				Latitude	Longitude			
70	1	11/3	0202-0233	06°26'S	139°52'W	0-140	1807.4	28
71	1	"	0249-0319	"	"	"	1755.8	44
73	1	"	2205-2234	08°36'S	139°31'W	"	1390.0	27
74	1	"	2235-2305	"	"	"	1408.0	28
76	1	11/4	0200-0230	08°54'S	139°38'W	"	854.4	55
77	1	"	0234-0304	"	"	"	715.8	71
79	1	"	2158-2228	09°13'S	141°35'W	"	2218.6	23
80	1	"	2231-2302	"	"	"	2168.1	33
82	1	11/5	0156-0226	09°12'S	142°00'W	"	1813.9	29
83	1	"	0228-0256	"	"	"	1786.6	24
84	1	"	2159-2229	09°15'S	142°46'W	"	1490.9	32
85	1	"	2232-2304	"	"	"	1580.6	33
87	1	11/6	0158-0229	09°18'S	142°23'W	"	1496.6	25
88	1	"	0234-0303	"	"	"	1449.6	31
90	1	"	2156-2226	09°15'S	140°33'W	"	1267.4	43
91	1	"	2228-2258	"	"	"	1192.9	48
93	1	11/7	0158-0228	09°13'S	140°10'W	"	1264.4	62
94	1	"	0232-0302	"	"	"	1074.6	64
97	1	11/9	0034-0104	11°20'S	142°19'W	"	1535.8	61
99	1	11/10	0032-0102	13°45'S	144°54'W	"	1738.3	30
103	1	11/14	0000-0031	16°53'S	148°58'W	"	1893.8	11
104	1	11/19	0000-0030	16°29'S	148°24'W	"	1863.0	10
106	1	11/20	0000-0031	14°46'S	145°48'W	"	1886.8	36
107	1	11/21	0000-0030	12°28'S	143°33'W	"	1663.5	36
108	1	11/22	0000-0030	10°14'S	141°18'W	"	1390.5	67
119	1	12/1	0508-0538	09°34'S	139°50'W	"	1705.9	33
120	1	"	0539-0611	"	"	0-143	1936.4	27
121	1	"	0805-0836	"	"	0-140	1709.6	23
122	1	"	0839-0908	"	"	"	1917.3	23
123	1	"	1105-1137	"	"	"	1681.6	23
124	1	"	1139-1210	"	"	"	1599.5	21
125	1	"	1406-1437	"	"	0-142	1765.8	20
126	1	"	1439-1510	"	"	"	1809.0	21
127	1	"	1705-1735	"	"	0-140	1361.9	32
128	1	"	1736-1807	"	"	"	1352.2	45
129	1	"	2003-2033	"	"	"	1375.9	33
130	1	"	2034-2106	"	"	"	1503.4	46
131	1	"	2305-2335	"	"	"	1481.8	39
132	1	12/1-2	2337-0006	"	"	"	1516.9	37
133	1	12/2	0204-0234	"	"	"	1564.6	44
134	1	"	0236-0305	"	"	"	1649.7	98
136	1	12/5	0000-0030	05°55'S	141°56'W	"	1728.8	28
137	1	12/6	0000-0030	02°55'S	143°32'W	0-147	1895.1	16
138	1	12/7	0000-0030	00°18'N	145°54'W	0-140	2282.6	31
139	1	12/8	0000-0028	03°06'N	146°44'W	"	2178.6	34
140	1	12/9	0000-0031	06°08'N	148°28'W	"	2148.7	25
141	1	12/10	0000-0031	09°10'N	150°10'W	"	2399.8	15
142	1	12/11	0000-0031	12°09'N	152°14'W	"	2255.6	14

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[1] All fish, fish eggs, jellies >2 cm. in length, and other organisms >5 cm. in length are not included.

Table 16.--Zooplankton station data and sample volumes, Hugh M. Smith cruise 43

Station	Sample	Date, 1958	Time[1]	Position		Depth, m.	Water strained, m.^{3}	Volume, cc./1000 m.^{3} [2]
				Latitude	Longitude			
1	1	1/5	2010-2042	18°04'N	155°45'W	0-140	1564.4	11
2	1	1/6	2012-2045	15°03'N	153°57'W	0-145	1899.8	6
3	1	1/7	2011-2042	12°13'N	152°12'W	0-155	1495.4	14
4	1	1/8	2008-2040	09°24'N	150°46'W	0-145	1332.9	33
5	1	1/9	2005-2030	06°42'N	149°00'W	0-144	1114.9	27
6	1	1/10	2012-2044	04°00'N	147°21'W	0-140	1615.7	18
7	1	1/11	2004-2035	01°21'N	145°55'W	0-148	1746.9	30
8	1	1/12	2003-2042	01°35'S	144°32'W	0-136	2199.2	43
9	1	1/13	2006-2037	04°32'S	142°49'W	0-146	1530.4	89
10	1	1/14	2004-2038	07°41'S	141°05'W	0-140	2186.5	86
22	1	1/23	1622-1655	09°34'S	139°50'W	0-145	1991.9	21
	2	"	1825-1855	"	"	"	2023.7	30
	3	"	2005-2040	"	"	0-158	2104.9	43
	4	"	2207-2238	"	"	0-140	1711.4	64
	5	1/24	0013-0048	"	"	"	2223.4	63
	6	"	0210-0241	"	"	0-141	1887.6	60
	7	"	0408-0438	"	"	0-148	1787.0	50
	8	"	0615-0649	"	"	0-158	1716.8	24
	9	"	0803-0832	"	"	0-140	1528.0	23
	10	"	1012-1042	"	"	0-149	1568.6	18
	11	"	1208-1245	"	"	0-158	1986.8	22
	12	"	1401-1431	"	"	0-140	1559.6	21
30	1	1/27	2116-2151	09°12'S	139°17'W	0-141	1755.7	65
32	1	1/28	0313-0342	09°12'S	138°48'W	0-160	1300.0	65
34	1	"	2110-2140	09°10'S	136°50'W	0-147	1750.6	26
36	1	1/29	0313-0343	09°10'S	136°18'W	0-145	1617.9	35
39	1	1/30	2109-2139	09°37'S	139°40'W	0-148	1688.4	25
41	1	1/31	0312-0342	10°14'S	139°38'W	"	1516.8	58
42	1	"	2112-2142	12°02'S	139°36'W	0-154	1466.3	15
44	1	2/1	0313-0343	12°31'S	139°34'W	0-185	1158.6	18
47	1	"	2110-2141	11°16'S	139°42'W	0-141	1551.1	51
49	1	2/2	0313-0343	10°43'S	139°39'W	"	582.7	98
57	1	2/5	2118-2145	09°07'S	141°05'W	"	1264.6	38
59	1	2/6	0319-0344	09°08'S	141°32'W	0-142	1384.6	41
60	1	"	2113-2143	09°13'S	143°02'W	0-140	1403.1	54
62	1	2/7	0315-0337	09°15'S	142°26'W	0-145	1468.9	27
64	1	"	2109-2133	09°13'S	140°41'W	0-167	1039.8	52
66	1	2/8	0318-0348	09°16'S	140°06'W	0-140	1511.9	35
70	1	2/9	2110-2137	07°35'S	139°40'W	"	1164.9	103
71	1	2/10	0330-0359	06°52'S	139°40'W	0-141	1386.1	26
73	1	"	2113-2142	05°37'S	139°50'W	0-140	1363.7	33
75	1	2/11	0319-0347	06°21'S	139°38'W	0-141	1279.6	48
76	1	"	2120-2146	08°30'S	139°40'W	0-140	957.7	100
78	1	2/12	0312-0341	09°03'S	139°45'W	"	1199.9	69
83	1	2/15	2002-2032	08°23'S	140°38'W	0-149	930.7	70
84	1	2/16	2005-2035	05°19'S	142°25'W	0-146	1137.2	27
85	1	2/17	2001-2031	02°10'S	144°08'W	0-149	1143.1	42

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[1] Stations 10 through 83 are on +9 ZT; others are on +10 ZT.

[2] Jellies >2 cm. in length and other organisms >5 cm. in length are not included.

Table 16.--Zooplankton station data and sample volumes, Hugh M. Smith cruise 43 (cont'd)

Station	Sample	Date, 1958	Time[1/]	Position		Depth, m.	Water strained, m.^{3}	Volume, cc./1000 m.^{3} [2/]
				Latitude	Longitude			
86	1	2/18	2007-2042	01°22'N	145°59'W	0-163	1172.0	64
87	1	2/19	2002-2032	04°40'N	147°23'W	0-161	1351.6	70
88	1	2/20	2010-2039	07°49'N	148°37'W	0-142	1506.1	27
89	1	2/21	2009-2033	11°06'N	150°42'W	0-140	1301.0	30
90	1	2/22	2005-2040	14°29'N	152°31'W	"	1965.1	19
91	1	2/23	2007-2037	17°25'N	154°52'W	"	1651.4	9
92	1	2/24	2005-2034	20°03'N	157°06'W	0-147	1278.4	18

[1/] Stations 10 through 83 are on +9 ZT; others are on +10 ZT.

[2/] Jellies >2 cm. in length and other organisms >5 cm. in length are not included.

Table 17.--Zooplankton station data and sample volumes, Charles H. Gilbert cruise 38

Station	Sample	Date, 1958	Time, +10 ZT	Position		Depth, m.	Water strained, m.^{3}	Volume, cc./1000 m.^{3} [1]
				Latitude	Longitude			
1	1	2/9	2023-2053	19°05'N	156°44'W	0-140	1722.5	58
2	1	2/10	2020-2051	16°26'N	155°19'W	"	1485.4	10
3	1	2/13	2005-2036	08°15'N	151°32'W	"	1836.9	56
4	1	2/14	2005-2036	05°31'N	150°06'W	"	1945.2	32
6	1	2/15	2012-2041	04°27'N	149°56'W	"	1444.9	44
8	1	2/16	2009-2036	03°28'N	149°58'W	"	1648.3	40
10	1	2/17	2019-2049	02°31'N	150°08'W	0-142	1716.4	38
12	1	2/18	2005-2036	01°30'N	150°15'W	0-140	1902.2	29
14	1	2/19	2003-2033	00°35'N	150°10'W	0-115	915.1	36
16	1	2/20	2005-2035	00°14'S	150°04'W	0-140	1702.5	62
18	1	2/21	2019-2052	01°10'S	149°44'W	"	1700.8	29
19	1	2/22	2002-2032	03°05'S	147°40'W	"	2045.3	29
20	1	2/23	2000-2031	04°59'S	145°02'W	"	2196.6	35
21	1	2/24	2006-2036	07°12'S	142°10'W	"	2084.7	43
34A	1	3/6	0706-0736	09°34'S	139°50'W	"	1885.5	11
B	1	"	0903-0933	"	"	0-141	1476.7	13
C	1	"	1105-1137	"	"	0-140	1896.6	14
D	1	"	1308-1338	"	"	"	1938.8	9
E	1	"	1508-1536	"	"	"	1486.8	12
F	1	"	1707-1737	"	"	0-142	1949.7	16
G	1	"	1906-1936	"	"	"	1902.2	24
H	1	"	2110-2140	"	"	0-140	1624.9	34
I	1	"	2306-2337	"	"	0-142	1737.6	40
J	1	3/7	0105-0135	"	"	0-140	1907.0	38
K	1	"	0303-0334	"	"	0-142	1884.9	53
L	1	"	0504-0534	"	"	0-140	1703.9	34
46	1	3/26	2104-2134	09°11'S	138°06'W	"	1416.2	41
48	1	3/27	0305-0335	09°09'S	137°34'W	0-142	1647.2	55
49	1	"	2004-2035	09°11'S	136°15'W	"	1703.6	36
51	1	3/28	0204-0234	09°07'S	136°56'W	0-140	1776.7	47
53	1	"	2022-2051	09°09'S	138°53'W	"	1394.2	79
55	1	3/29	0203-0232	09°08'S	139°27'W	"	1338.6	73
57	1	"	2004-2034	07°32'S	139°46'W	0-142	1275.6	60
59	1	3/30	0205-0236	06°57'S	139°44'W	"	1363.8	35
60	1	"	2002-2032	05°44'S	139°40'W	0-140	1644.4	38
62	1	3/31	0207-0237	06°20'S	139°39'W	"	1505.8	47
64	1	"	2003-2033	08°10'S	139°44'W	0-142	1475.9	102
66	1	4/1	0206-0236	08°38'S	139°57'W	"	1456.4	61
69	1	4/3	2004-2034	09°08'S	141°14'W	0-140	1543.7	45
71	1	4/4	0209-0239	09°07'S	141°52'W	"	1751.3	43
72	1	"	2002-2033	09°05'S	142°58'W	0-142	1885.5	35
74	1	4/5	0204-0234	09°04'S	142°28'W	"	1657.8	52
75	1	"	2003-2032	09°09'S	140°28'W	0-140	1212.8	48
77	1	4/6	0209-0239	09°12'S	139°57'W	"	1333.3	72
78	1	"	2007-2037	10°52'S	139°45'W	0-142	1407.8	38
80	1	4/7	0204-0235	11°28'S	139°48'W	0-140	1627.7	37
81	1	"	2003-2033	12°32'S	139°43'W	"	1546.5	47
83	1	4/8	0205-0235	12°00'S	139°41'W	"	1921.8	42
84	1	"	2000-2030	10°02'S	139°44'W	0-142	1406.7	70
86	1	4/9	0202-0232	09°24'S	139°51'W	"	1536.7	51

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[1] Jellies >2 cm. in length and other organisms >5 cm. in length are not included.

Table 17. --Zooplankton station data and sample volumes, *Charles H. Gilbert* cruise 38 (cont'd)

Sta-tion	Sam-ple	Date, 1958	Time, +10 ZT	Position		Depth, m.	Water strained, $m.^3$	Volume, cc./1000 $m.^3$ [1]
				Latitude	Longitude			
93A	1	4/17	1211-1241	09°34'S	139°50'W	0-140	1608.2	27
B	1	"	1403-1433	"	"	"	1629.9	23
C	1	"	1602-1632	"	"	"	1512.7	32
D	1	"	1803-1833	"	"	0-142	1847.0	51
E	1	"	2002-2032	"	"	0-140	1630.8	59
F	1	"	2206-2236	"	"	"	1719.8	59
G	1	4/18	0002-0033	"	"	0-142	1697.4	70
H	1	"	0202-0232	"	"	"	1668.4	49
I	1	"	0403-0433	"	"	[2]	1478.7	45
J	1	"	0602-0632	"	"	0-140	1478.4	31
K	1	"	0803-0834	"	"	0-142	1696.3	35
L	1	"	1002-1032	"	"	0-140	1573.3	30
98	1	4/21	2008-2037	08°02'S	140°50'W	[2]	1350.4	50
99	1	4/22	2001-2031	05°21'S	142°26'W	0-142	1582.5	26
100	1	4/23	2003-2033	02°34'S	144°12'W	0-140	1932.6	50
101	1	4/24	2000-2029	00°22'N	145°57'W	"	1935.7	67
102	1	4/25	2003-2033	03°15'N	147°40'W	"	1733.4	52
103	1	4/26	2000-2030	06°02'N	149°07'W	0-138	1537.8	56
104	1	4/28	2004-2034	11°44'N	152°31'W	0-140	1652.2	32
105	1	4/29	2002-2032	14°40'N	154°09'W	"	1503.5	18
106	1	4/30	2006-2036	17°42'N	155°40'W	"	1560.4	17

[1] Jellies >2 cm. in length and other organisms >5 cm. in length are not included.

[2] Depth of tow uncertain due to failure of metering apparatus.

Table 18.--Zooplankton station data and sample volumes, Hugh M. Smith cruise 45

Station	Sample	Date, 1958	Time 1/	Position		Depth, m.	Water strained, $m.^3$	Volume, cc./1000 $m.^3$ 4/
				Latitude	Longitude			
1	1	3/29	2019-2045	18°29'N	155°22'W	0-135	1388.9	13
2	1	3/30	2014-2044	16°12'N	153°04'W	0-132	1545.8	12
3	1	3/31	2008-2035	14°14'N	151°00'W	0-144	1231.3	26
4	1	4/1	2010-2038	12°11'N	148°46'W	0-132	1348.5	23
5	1	4/2	2016-2041	10°08'N	146°29'W	0-127	1077.6	38
6	1	4/3	2013-2039	08°05'N	144°11'W	0-140	1319.8	42
7	1	4/4	2108-2138	06°08'N	141°42'W	0-130	1458.1	47
78	1	5/15	2004-2030	09°08'S	138°10'W	0-140	1392.8	19
79	1	5/16	0317-0346	09°12'S	137°22'W	0-161	1611.1	20
82	1	"	2000-2028	09°10'S	136°10'W	0-140	1432.8	37
83	1	5/17	0320-0347	09°13'S	137°02'W	0-139	1321.9	26
84	1	"	1959-2029	09°12'S	139°07'W	0-125	1601.3	34
87	1	5/19	2000-2029	09°12'S	141°22'W	0-140	1578.1	62
88	1	5/20	0313-0343	09°12'S	142°02'W	0-137	1357.3	31
90	1	"	1955-2026	09°12'S	143°08'W	0-140	1536.0	30
91	1	5/21	0309-0338	09°14'S	142°20'W	"	1592.1	34
94	1	"	2002-2031	09°12'S	140°36'W	0-137	1359.1	80
97	1	5/23	2001-2030	07°39'S	139°45'W	0-140	1421.6	25
98	1	5/24	0314-0343	06°54'S	139°41'W	"	1426.5	21
101	1	"	1958-2028	05°38'S	139°40'W	0-138	1491.0	40
102	1	5/25	0310-0344	06°24'S	139°38'W	0-140	1759.2	24
105	1	"	1959-2034	08°25'S	139°42'W	0-137	1926.3	24
107	1	5/27	2000-2028	10°55'S	139°40'W	0-139	1301.2	66
108	1	5/28	0312-0339	11°30'S	139°39'W	0-144	2165.0	15
110	1	"	2001-2040	12°41'S	139°39'W	0-133	2347.5	21
111	1	5/29	0306-0336	11°58'S	139°40'W	0-124	1459.1	23
113	1	"	1953-2025	10°11'S	139°34'W	0-140	1928.4	76
114	1	5/30	0315-0351	09°25'S	139°34'W	0-146	944.9	73
120	1	6/8	1522-1552	09°34'S	139°50'W	0-122	937.5	38
	2	"	" "	"	"	112-230	606.7	14
121	1	"	1710-1739	"	"	0-125	797.5	49
	2	"	" "	"	"	96-239	445.0	22
122	1	"	1914-1941	"	"	0-126	845.2	88
	2	"	" "	"	"	112-238	1041.1	7
123	1	"	2105-2133	"	"	0-126	941.4	87
	2	"	" "	"	"	71-238	1003.0	6
124	1	"	2313-2347	"	"	0-137	865.6	128
	2	"	" "	"	"	103-240	394.6	19
125	1	6/9	0110-0144	"	"	0-137	852.6	117
	2	"	" ? 2/	"	"	70-240	1482.7	12
126	1	"	0308-0335	"	"	0-121	794.0	106
	2	"	" "	"	"	107-229	598.8	9
127	1	"	0510-0539	"	"	0-126	817.8	126
	2	"	" "	"	"	103-238	681.1	15
128	1	"	0711-0737	"	"	0-125	794.3	112
	2	"	" "	"	"	94-245	447.1	12
129	1	"	0910-0937	"	"	0-126	718.5	106
	2	"	" "	"	"	76-238	939.8	14
130	1	"	1108-1149	"	"	0-150	855.4	63
	2	"	" "	"	"	71-262	71.3 3/	196

1/ Stations 7 through 148 are on +9 ZT; others are on +10 ZT.
2/ Messenger time was not recorded.
3/ Flowmeter reading was extremely low.
4/ Jellies >2 cm. in length and other organisms >5 cm. in length are not included.

Table 18. --Zooplankton station data and sample volumes, *Hugh M. Smith* cruise 45 (cont'd)

Station	Sample	Date, 1958	Time[1/]	Position		Depth, m.	Water strained, m.^{3}	Volume, cc./1000 m.^{3} [4/]
				Latitude	Longitude			
131	1	6/9	1306-1333	09°34'S	139°50'W	0-123	702.0	32
	2	"	" "	"	"	116-239	920.6	15
134	1	6/12	2000-2030	08°33'S	139°34'W	0-138	1623.7	20
135	1	6/13	2002-2038	05°20'S	139°16'W	0-140	2328.5	15
139	1	6/14	1958-2027	02°46'S	139°42'W	0-138	1411.0	200
144	1	6/15	2002-2027	01°02'N	141°02'W	0-140	1211.0	76
148	1	6/16	2002-2038	04°00'N	142°59'W	0-137	1322.6	159
151	1	6/17	2010-2040	06°48'N	144°40'W	0-134	1832.9	62
155	1	6/18	2009-2039	09°13'N	146°43'W	0-140	1534.2	64
156	1	6/19	2010-2043	12°02'N	149°03'W	0-144	1969.8	26
157	1	6/20	2011-2043	14°42'N	151°11'W	0-117	1958.6	25
158	1	6/21	2010-2043	17°14'N	153°40'W	0-134	1950.9	18
159	1	6/22	2009-2045	19°36'N	156°26'W	0-140	2176.9	22

[1/] Stations 7 through 148 are on +9 ZT; others are on +10 ZT.

[4/] Jellies >2 cm. in length and other organisms >5 cm. in length are not included.

Table 19. --Common and scientific names of fish caught

Yellowfin tuna	*Neothunnus macropterus* (Temminck and Schlegel)
Bigeye tuna	*Parathunnus sibi* (Temminck and Schlegel)
Skipjack	*Katsuwonus pelamis* (Linnaeus)
Little tuna	*Euthynnus yaito* Kishinouye
Dogtooth tuna	*Gymnosarda nuda* (Günther)
Dolphin	*Coryphaena hippurus* Linnaeus
Shortnosed spearfish	*Tetrapturus angustirostris* Tanaka
Black marlin	*Istiompax marlina* (Jordan and Hill)
Blue marlin	*Makaira ampla* (Poey)
Striped marlin	*Makaira audax* (Philippi)
Wahoo	*Acanthocybium solandri* (Cuvier and Valenciennes)
Whitetip shark	*Pterolamiops longimanus* (Poey)
Silky shark	*Eulamia floridanus* (Bigelow, Schroeder, and Springer)
Great blue shark	*Prionace glauca* (Linnaeus)
Bigeye thresher shark	*Alopias superciliosus* (Lowe)
Bonito shark	*Isurus glaucus* Müller and Henle
Hammerhead shark	*Sphyrna lewini* (Griffith)
Puffer	*Lagocephalus lagocephalus* (Linnaeus)
Marquesan sardine	*Harengula vittata* (Cuvier and Valenciennes)
Red snapper	*Lutjanus bohar* (Forskål)
Green snapper	*Aprion virescens* Cuvier and Valenciennes
Jack	*Caranx ignobilis* (Forskål)
Jack	*Caranx lugubris* Poey
Jack	*Caranx melampygus* Cuvier and Valenciennes
Barracuda	*Sphyraena nigripinnis* Temminck and Schlegel
Spiny puffer	*Diodon* sp.
Rainbow runner	*Elagatis bipinnulatus* (Quoy and Gaimard)

Table 20.--Surface troll catch and related data, Charles H. Gilbert cruise 35

Date, 1957	Time, LT	Position		Species	Number[1]	Average length, cm.
		Latitude	Longitude			
10/3	0715	19°47'N	156°19'W	Dolphin	1	112.5
10/4	-	-	-	Dolphin	1	53.1
10/6	1130	10°12'N	150°36'W	Dolphin	1	-
10/8	1730	03°55'N	146°41'W	Skipjack	1	70.7
10/11	1630	05°09'S	142°22'W	Skipjack	2	78.8
10/12	1730	08°04'S	140°43'W	Wahoo	1	133.3
10/14	0545	08°58'S	140°10'W	Wahoo	3	130.5
10/14	0600	08°58'S	140°02'W	Little tuna	1	68.3
10/14	0620	08°46'S	140°15'W	Yellowfin	2	90.4
10/14	0940	08°40'S	140°35'W	Little tuna	1	55.1
10/14	0940	08°40'S	140°35'W	Yellowfin	2	82.4
10/14	0940	08°40'S	140°35'W	Wahoo	3	137.5
10/14	0948	08°39'S	140°35'W	Green snapper	5	75.4
10/14	1602	08°00'S	140°44'W	Wahoo	1	148.2
10/15	0510	07°58'S	140°41'W	Yellowfin	8	95.5
10/15	0515	07°58'S	140°40'W	Little tuna	7	66.8
10/15	0607	07°52'S	140°36'W	Wahoo	1	136.4
10/15	0620	07°52'S	140°34'W	Little tuna	2	60.8
10/15	0630	07°50'S	140°33'W	Yellowfin	1	80.7
10/15	1345	07°58'S	139°49'W	Yellowfin	1	60.1
10/17	1000	09°25'S	138°56'W	Jack	2	78.5
10/17	1000	09°25'S	138°56'W	Red snapper	1	80.0
10/17	1010	09°26'S	138°54'W	Jack	4	66.5
10/17	1025	09°30'S	138°52'W	Green snapper	1	80.7
10/17	1030	09°30'S	138°52'W	Yellowfin	1	88.1
10/18	0655	10°02'S	138°50'W	Skipjack	1	47.0
10/19	1002	10°04'S	139°09'W	Wahoo	1	131.1
10/24	0940	09°07'S	139°20'W	Dolphin	1	96.2
10/24	1530	09°08'S	138°38'W	Dolphin	1	96.9
10/26	1302	09°14'S	137°53'W	Yellowfin	1	117.0
10/27	0630	09°28'S	139°38'W	Wahoo	1	103.6
10/29	1045	11°21'S	140°25'W	Dolphin	1	-
11/1	0610	09°08'S	139°38'W	Dolphin	1	93.6
11/1	1400	08°06'S	139°36'W	Dolphin	2	92.2
11/1	1405	08°06'S	139°36'W	Yellowfin	1	88.9
11/1	1405	08°06'S	139°36'W	Wahoo	1	148.5
11/2	0610	06°45'S	139°28'W	Dolphin	1	101.9
11/3	0700	06°54'S	139°50'W	Skipjack	1	78.3
11/3	1700	08°00'S	139°36'W	Skipjack	1	51.6
11/4	1045	09°14'S	140°18'W	Spiny puffer	1	-

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[1] Fish of the same species caught within a 1-hour interval were combined in a single number.

Table 20.--Surface troll catch and related data, *Charles H. Gilbert* cruise 35 (cont'd)

Date, 1957	Time, LT	Position		Species	Number[1]	Average length, cm.
		Latitude	Longitude			
11/5	1625	09°12'S	143°20'W	Wahoo	1	80.2
11/19	0630	15°56'S	147°48'W	Yellowfin	1	60.4
11/24	0850	08°39'S	140°36'W	Green snapper	1	71.0
11/24	0855	08°34'S	140°40'W	Yellowfin	1	119.5
11/25	0545	07°54'S	140°40'W	Yellowfin	1	111.0
11/25	0835	07°48'S	140°19'W	Little tuna	1	61.9
11/25	0840	07°48'S	140°42'W	Jack	1	54.0
11/25	0905	07°48'S	140°16'W	Green snapper	2	71.9
11/25	1500	08°35'S	139°38'W	Green snapper	2	71.9
11/25	1505	08°36'S	139°38'W	Little tuna	1	45.7
11/25	1507	08°36'S	139°38'W	Dogtooth tuna	1	78.5
11/27	0850	09°18'S	139°04'W	Dogtooth tuna	2	107.7
11/27	0850	09°18'S	139°04'W	Red snapper	6	-
11/27	0852	09°18'S	139°04'W	Jack	7	-
11/27	0900	09°20'S	139°02'W	Green snapper	2	-
11/27	0923	09°22'S	139°00'W	Jack	2	-
11/27	0923	09°22'S	139°00'W	Jack	1	-
11/27	0930	09°22'S	138°59'W	Little tuna	1	-
11/27	0947	09°23'S	138°58'W	Wahoo	1	-
11/27	0950	09°23'S	138°58'W	Rainbow runner	1	-
11/27	1430	09°50'S	138°55'W	Dolphin	1	86.0
11/29	1210	09°52'S	139°06'W	Wahoo	1	129.0
11/30	1715	08°58'S	140°05'W	Yellowfin	2	64.3
12/4	0610	07°58'S	140°44'W	Wahoo	3	130.4
12/4	0654	07°56'S	140°42'W	Yellowfin	3	80.6
12/4	0654	07°56'S	140°42'W	Little tuna	6	56.0
12/8	0730	03°52'N	147°15'W	Skipjack	1	59.8
12/8	1335	04°46'N	147°48'W	Skipjack	3	60.0
12/11	1525	14°06'N	152°21'W	Wahoo	1	134.0
12/13	0930	19°14'N	156°12'W	Yellowfin	2	61.1

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[1] Fish of the same species caught within a 1-hour interval were combined in a single number.

Table 21.--Surface troll catch and related data, Hugh M. Smith cruise 43

Date, 1958	Time, LT	Position		Species	Number[1]	Average length, cm.
		Latitude	Longitude			
1/7	1130	13°14'N	152°42'W	Dolphin	1	85.6
1/7	1800	12°26'N	152°18'W	Dolphin	1	96.8
1/13	1425	03°57'S	143°11'W	Yellowfin	1	-
1/15	0630	-	-	Wahoo	2	142.7
1/18	0700	08°54'S	140°17'W	Wahoo	1	137.2
1/18	0940	08°41'S	140°36'W	Wahoo	1	117.8
1/19	1015	07°48'S	140°13'W	Wahoo	1	160.8
1/20	0625	08°10'S	139°33'W	Yellowfin	1	73.2
1/21	1212	09°25'S	138°54'W	Jack	1	-
1/21	1222	09°27'S	138°53'W	Jack	4	-
1/21	1235	09°28'S	138°52'W	Red snapper	3	-
1/21	1300	09°29'S	138°52'W	Great blue shark	1	-
1/22	-	-	-	Wahoo	1	157.5
1/23	1405	09°48'S	139°36'W	Yellowfin	3	57.3
1/24	1645	09°25'S	140°07'W	Dolphin	1	105.5
1/25	0640	09°18'S	140°05'W	Yellowfin	2	72.9
1/27	1600	09°05'S	139°46'W	Yellowfin	3	52.2
2/11	1620	08°00'S	139°34'W	Yellowfin	1	73.6
2/11	1830	08°17'S	139°40'W	Wahoo	1	-
2/15	1515	08°59'S	140°10'W	Dolphin	1	108.0
2/22	0640	12°38'N	151°27'W	Dolphin	1	92.2
2/23	0955	16°14'N	153°48'W	Dolphin	1	78.1
2/23	1220	16°33'N	154°03'W	Dolphin	1	86.0
2/23	1715	17°02'N	154°28'W	Dolphin	1	72.5

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[1] Fish of the same species caught within a 1-hour interval were combined in a single number.

Table 22.--Surface troll catch and related data, *Charles H. Gilbert* cruise 38

Date, 1958	Time, LT	Position		Species	Number1/	Average length, cm.
		Latitude	Longitude			
2/10	0840	17°46'N	155°58'W	Dolphin	2	107.8
2/10	1950	17°38'N	155°54'W	Dolphin	1	79.1
2/11	1505	14°26'N	154°21'W	Dolphin	1	80.8
2/14	1730	05°51'N	150°05'W	Puffer	1	-
2/25	0845	08°19'S	140°44'W	Wahoo	1	96.5
2/25	1000	08°27'S	140°38'W	Dolphin	1	123.2
2/25	1435	08°55'S	140°16'W	Yellowfin	1	80.8
2/25	1450	08°57'S	140°14'W	Little tuna	1	59.9
2/25	1450	08°57'S	140°14'W	Rainbow runner	1	55.7
2/27	0625	08°58'S	140°11'W	Yellowfin	1	74.0
2/27	0905	08°48'S	140°18'W	Yellowfin	2	75.8
2/27	1620	08°01'S	140°44'W	Little tuna	1	79.4
2/27	1620	08°01'S	140°44'W	Rainbow runner	1	97.5
2/28	0625	07°55'S	140°40'W	Yellowfin	1	127.1
2/28	1215	07°47'S	140°08'W	Yellowfin	2	77.8
2/28	1642	08°04'S	139°38'W	Yellowfin	1	81.8
2/28	1642	08°04'S	139°38'W	Little tuna	2	56.9
3/1	0530	08°06'S	139°38'W	Wahoo	1	113.0
3/1	1340	08°52'S	139°25'W	Skipjack	2	49.0
3/2	1212	09°29'S	138°53'W	Green snapper	4	-
3/2	1212	09°29'S	138°53'W	Jack	3	-
3/2	1216	09°29'S	138°53'W	Red snapper	1	-
3/2	1550	09°48'S	138°50'W	Yellowfin	2	68.8
3/26	1000	09°11'S	139°13'W	Barracuda	1	103.4
4/3	0920	09°09'S	140°14'W	Barracuda	1	87.5
4/3	1620	09°10'S	140°51'W	Barracuda	1	107.7
4/7	1445	12°48'S	139°46'W	Barracuda	1	91.5
4/9	0705	08°50'S	140°03'W	Dolphin	1	96.0
4/11	0525	08°58'S	140°10'W	Yellowfin	1	74.4
4/11	0942	08°40'S	140°34'W	Green snapper	2	75.2
4/11	1005	08°38'S	140°35'W	Dogtooth tuna	1	111.2
4/11	1720	08°05'S	140°42'W	Little tuna	2	56.2
4/12	0520	07°57'S	140°41'W	Yellowfin	2	82.2
4/12	0525	07°57'S	140°41'W	Wahoo	2	135.6
4/12	0600	07°53'S	140°38'W	Little tuna	1	79.5
4/12	1428	07°55'S	139°59'W	Wahoo	1	117.3
4/12	1428	07°55'S	139°59'W	Little tuna	1	-
4/14	0950	09°25'S	139°04'W	Wahoo	1	143.4
4/14	1455	09°48'S	138°50'W	Wahoo	2	126.2
4/14	1627	09°53'S	138°58'W	Skipjack	1	50.7
4/16	1105	10°02'S	139°07'W	Yellowfin	3	91.4
4/16	1115	10°00'S	139°07'W	Wahoo	3	128.5
4/19	0515	09°20'S	140°04'W	Wahoo	3	126.6
4/19	1025	09°07'S	140°04'W	Dolphin	1	110.7
4/22	1425	05°58'S	142°02'W	Dolphin	2	75.8
4/24	1745	00°06'N	145°47'W	Skipjack	2	47.0

1/ Fish of the same species caught within a 1-hour interval were combined in a single number.

Table 23.--Surface troll catch and related data, Hugh M. Smith cruise 45

Date, 1958	Time, LT	Position		Species	Number[1]	Average length, cm.
		Latitude	Longitude			
3/30	1405	16°45'N	153°41'W	Dolphin	1	116.0
3/30	1730	16°24'N	153°19'W	Dolphin	1	94.2
4/5	1445	04°39'N	140°01'W	Skipjack	1	70.2
4/29	1430	06°53'S	144°19'W	Wahoo	1	138.0
5/15	1500	09°08'S	138°40'W	Skipjack	1	50.8
5/19	1750	09°12'S	141°06'W	Yellowfin	2	54.8
5/21	0750	09°15'S	141°53'W	Yellowfin	2	60.6
5/21	1655	09°13'S	140°54'W	Yellowfin	2	60.2
5/24	0650	06°33'S	139°38'W	Skipjack	1	74.9
5/25	1700	08°02'S	139°40'W	Wahoo	1	140.8
5/25	1702	08°02'S	139°40'W	Yellowfin	1	79.0
5/28	0815	11°57'S	139°41'W	Skipjack	2	49.5
5/28	1600	12°45'S	139°40'W	Skipjack	1	46.7
5/29	1735	10°26'S	139°36'W	Yellowfin	1	88.0
6/1	0730	08°56'S	140°16'W	Yellowfin	2	74.5
6/5	1200	09°27'S	138°54'W	Jack	2	107.2
6/6	1040	09°53'S	139°09'W	Wahoo	1	143.7
6/6	1200	09°45'S	139°10'W	Wahoo	1	145.5
6/7	0718	09°57'S	138°50'W	Wahoo	1	147.7
6/12	1700	08°47'S	139°49'W	Dolphin	1	80.4
6/21	1000	16°19'N	152°25'W	Wahoo	1	111.5

[1] Fish of the same species caught within a 1-hour interval were combined in a single number.

Table 24.--Longline station data and catch per 100 hooks, *Charles H. Gilbert* cruise 38

Station	Date, 1958	Noon position		Number of baskets	Number of hooks	Catch per 100 hooks		
		Latitude	Longitude			Yellowfin	Bigeye	Skipjack
5	2/15	04°44'N	150°05'W	44	479	-	0.4	-
7	2/16	03°52'N	150°00'W	44	480	0.2	-	-
9	2/17	02°57'N	150°17'W	44	479	1.7	0.2	0.4
11	2/18	01°53'N	150°20'W	44	480	1.0	0.2	0.2
13	2/19	00°53'N	150°19'W	44	478	0.4	0.8	0.2
15	2/20	00°11'N	150°02'W	44	480	0.4	0.4	-
17	2/21	00°45'S	150°12'W	44	479	0.2	0.2	-

Table 25.--Longline catch record in numbers, length, and sex of fish, *Charles H. Gilbert* cruise 38

Station	Yellowfin[1]		Bigeye[1]		Skipjack		Marlin	Shark
	No.	Length and sex[2]	No.	Length and sex[2]	No.	Length and sex[2]		
5	-	-	2	121.9F, 116.4	-	-	1	2
7	1	131.4	-	-	-	-	1	5
9	8	131.8, 132.0, 119.9F, 124.2M, 126.6F, 124.9, 129.7M, 140.2	1	110.6F	2[3]	66.4M	-	1
11	5	136.7F, 141.7M, 127.0F, 135.8M, 142.2	1	149.8M	1	71.6F	2	3
13	2	145.1M, 150.2M	4[3]	142.3F, 138.6F, 126.4M	1	76.8F	1	1
15	2	138.3M, 153.9M	2	168.9M, 162.3M	-	-	-	4
17	1	138.7	1	169.1M	-	-	-	3

[1] Those fish for which no sex data recorded were tagged and released.

[2] Fork length in centimeters; M = male, F = female.

[3] This number includes one shark damaged specimen which was not measured.

Table 26.--Summary of pole-and-line fishing, Charles H. Gilbert cruise 35

Date, 1957	Time, LT	Position		Number of passes	Number of minutes chummed	Number caught and species[1]	Amount of bait, buckets
		Latitude	Longitude				
10/14	0650	08°53'S	140°17'W	2	15	0 YF	1.0
10/14	1333	08°15'S	140°37'W	2	4	0 ?	.5
10/14	1531	08°05'S	140°41'W	2	4	0 ?	.5
10/16	0625	08°08'S	139°36'W	2	9	0 DO	.5
10/16	1328	08°51'S	139°20'W	2	5	0 ?	1.0
10/16	1354	08°53'S	139°23'W	2	9	0 ?	-
10/17	1210	09°39'S	138°49'W	2	4	0 ?	1.0
10/17	1240	09°42'S	138°47'W	1	1	0 ?	-
10/18	0659	10°02'S	138°50'W	2	26	120 SJ	8.0
10/18	1354	10°23'S	138°37'W	3	6	0 ?	1.0
10/19	0702	10°18'S	138°53'W	2	8	0 ?	4.0
10/19	0726	10°16'S	138°56'W	2	10	42 SJ	7.0
10/19	0837	10°13'S	138°59'W	1	1	0 ?	.5
10/19	1012	10°03'S	139°09'W	2	2	0 ?	1.0
10/19	1042	10°01'S	139°09'W	1	6	0 ?	-
10/19	1055	09°59'S	139°11'W	1	2	0 ?	-
10/20	1427	09°27'S	140°10'W	2	5	0 YF and SJ	2.0
10/26	0757	09°13'S	137°11'W	1	2	0 SJ	1.0
10/26	1300	09°13'S	137°50'W	1	2	0 YF	.5
10/27	0921	09°46'S	139°38'W	2	8	0 YF and SJ	2.0
10/27	0946	09°50'S	139°34'W	7	26	43 SJ, 5 YF	16.5
10/27	1314	10°02'S	139°34'W	1	1	0 ?	1.0
10/27	1441	10°15'S	139°34'W	1	1	0 ?	1.0
11/3	0719	06°56'S	139°53'W	1	2	0 SJ	1.0
11/3	0807	07°00'S	139°57'W	2	6	0 SJ	2.0
11/3	0854	07°01'S	139°56'W	1	2	0 SJ	1.0
11/3	1244	07°31'S	139°52'W	1	30	182 SJ	9.0
11/4	0928	09°13'S	140°09'W	4	11	0 ?	1.0
11/4	1312	09°13'S	140°34'W	2	9	0 ?	2.0
11/4	1538	09°13'S	140°43'W	4	19	158 SJ	11.0
11/6	1210	09°15'S	141°21'W	4	22	75 SJ, 4 YF	6.5
11/10	0907	14°20'S	145°58'W	7	18	0 YF	10.0
11/10	1017	14°20'S	146°02'W	1	1	0 ?	.5
11/10	1034	14°23'S	146°04'W	2	7	0 ?	3.0
11/10	1145	14°29'S	146°05'W	1	18	144 YF	14.0
11/11	0625	14°33'S	146°07'W	2	9	4 SJ	1.0
11/12	1425	15°04'S	148°00'W	1	2	0 ?	1.0
11/12	1602	14°57'S	147°32'W	1	2	0 ?	.5
11/12	1628	14°56'S	147°38'W	5	26	415 SJ	18.0
11/19	0929	15°37'S	147°25'W	11	28	209 SJ	15.0

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[1] SJ = skipjack, YF = yellowfin, DO = dolphin

Table 26.--Summary of pole-and-line fishing, Charles H. Gilbert cruise 35 (cont'd)

Date, 1957	Time, LT	Position		Number of passes	Number of minutes chummed	Number caught and species 1/	Amount of bait, buckets
		Latitude	Longitude				
11/24	1237	08°12'S	140°41'W	6	13	87 SJ	12.0
11/24	1341	08°12'S	140°41'W	1	25	480 SJ	18.0
11/25	0938	07°51'S	140°11'W	1	7	0 ?	5.0
11/25	1013	07°52'S	140°10'W	4	4	6 SJ	6.0
11/26	1305	08°56'S	139°29'W	1	2	0 ?	.5
11/26	1334	08°59'S	139°31'W	6	33	28 SJ	15.0
11/27	1138	09°42'S	138°47'W	2	3	0 ?	1.0
11/27	1210	09°45'S	138°46'W	4	8	0 ?	2.0
11/28	1154	10°01'S	138°51'W	1	3	0 ?	1.0
11/28	1254	10°08'S	138°50'W	6	20	233 SJ	14.0
11/29	0801	10°19'S	138°52'W	4	7	0 ?	3.0
11/29	1009	10°01'S	139°09'W	3	11	26 SJ, 2 YF	6.0

1/ SJ = skipjack, YF = yellowfin

Table 27.--Summary of pole-and-line fishing, Hugh M. Smith cruise 43

Date, 1958	Time, LT	Position		Number of passes	Number of minutes chummed	Number caught and species[1]	Amount of bait, buckets
		Latitude	Longitude				
1/18	1039	08°34'S	140°38'W	1	31	210 SJ	14.0
1/18	1435	08°15'S	140°43'W	2	18	0 SJ	-
1/18	1545	08°05'S	140°45'W	4	10	8 SJ	2.0
1/19	1040	07°50'S	140°14'W	5	18	0 SJ	-
1/19	1140	07°51'S	140°14'W	4	11	0 SJ	-
1/20	1203	08°52'S	139°16'W	1	3	0 ?	-
1/20	1324	08°48'S	139°14'W	1	1	0 ?	.5
1/20	1407	08°52'S	139°21'W	7	18	0 SJ	5.0
1/21	0739	09°10'S	139°14'W	1	5	0 SJ	1.0
1/21	0837	09°14'S	139°10'W	1	4	0 SJ	1.0
1/21	1000	09°18'S	139°03'W	1	5	0 YF	1.0
1/21	1025	09°20'S	139°00'W	5	16	4 SJ	3.0
1/21	1410	09°30'S	138°51'W	1	3	0 YF	1.0
1/22	1044	10°03'S	138°53'W	2	7	0 YF and SJ	1.0
1/22	1059	10°04'S	138°52'W	6	16	9 SJ, 1 YF	12.0
1/22	1537	10°19'S	138°28'W	1	3	0 YF and SJ	1.0
1/22	1621	10°27'S	138°30'W	1	2	0 YF and SJ	1.0
1/23	1106	10°00'S	139°23'W	6	16	0 SJ	8.0
1/25	0834	09°09'S	140°08'W	4	23	193 SJ	13.0
1/28	0748	09°13'S	138°18'W	4	7	0 ?	4.5
1/28	0908	09°16'S	138°12'W	1	1	0 SJ	.5
1/28	0932	09°15'S	138°06'W	1	3	0 ?	2.0
1/28	1340	09°19'S	137°35'W	3	14	0 SJ	9.0
1/28	1551	09°18'S	137°25'W	1	19	147 SJ	10.0
1/29	0943	09°10'S	136°29'W	1	12	45 SJ	15.0
1/29	1057	09°10'S	136°39'W	1	4	0 SJ	3.0
1/30	1238	09°12'S	139°24'W	3	12	0 ?	4.0
1/30	1402	09°10'S	139°31'W	5	16	0 SJ	12.0
1/30	1548	09°08'S	139°38'W	2	5	0 SJ	3.0
1/30	1633	09°08'S	139°38'W	1	23	92 SJ	10.0
1/30	1658	09°05'S	139°36'W	1	1	0 ?	1.0
2/1	0743	12°48'S	139°36'W	2	8	0 SJ	3.0
2/1	0953	12°34'S	139°40'W	1	5	5 SJ	3.5
2/1	1343	12°02'S	139°37'W	1	10	0 SJ	1.0
2/1	1527	11°52'S	139°40'W	3	19	91 SJ	8.0
2/2	1135	09°42'S	139°39'W	1	10	79 SJ	15.0
2/2	1425	09°17'S	139°41'W	1	3	0 SJ	.5
2/2	1436	09°14'S	139°04'W	3	10	0 SJ	1.5
2/5	1233	09°12'S	140°32'W	2	6	0 SJ	4.0
2/5	1313	09°12'S	140°34'W	1	3	0 ?	1.0
2/5	1717	09°09'S	140°45'W	1	2	0 SJ	1.0
2/6	0907	09°08'S	142°10'W	1	3	0 ?	1.0
2/7	1229	09°14'S	141°24'W	5	18	0 SJ	7.0
2/7	1426	09°12'S	141°16'W	2	25	137 SJ	15.0
2/9	0739	09°00'S	139°38'W	1	6	32 SJ	5.0
2/10	1054	06°05'S	139°31'W	1	4	0 SJ	1.0
2/10	1228	05°56'S	139°32'W	1	3	0 ?	.5
2/10	1316	05°56'S	139°27'W	1	4	0 ?	1.0
2/10	1346	06°00'S	139°45'W	3	17	108 SJ	7.5

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[1] SJ = skipjack, YF = yellowfin

Table 28.--Summary of pole-and-line fishing, *Charles H. Gilbert* cruise 38

Date, 1958	Time, LT	Position		Number of passes	Number of minutes chummed	Number caught and species[1]	Amount of bait, buckets
		Latitude	Longitude				
2/27	0755	08°49'S	140°16'W	3	16	76 SJ and YF	10.0
2/28	1040	07°46'S	140°14'W	1	5	0 SJ and YF	2.0
2/28	1200	07°43'S	140°10'W	1	3	0 YF	1.0
2/28	1430	07°57'S	139°47'W	2	9	32 SJ and YF	7.0
3/1	0545	08°08'S	139°36'W	5	11	9 SJ	9.0
3/1	0745	08°21'S	139°30'W	4	9	0 SJ	2.5
3/1	0952	08°23'S	139°26'W	2	3	0 SJ and YF	1.0
3/2	0940	09°22'S	139°02'W	4	6	30 SJ	7.0
3/3	0945	10°01'S	138°52'W	4	15	229 SJ	14.0
3/3	1115	10°06'S	138°51'W	2	5	0 SJ	1.0
3/4	0955	10°04'S	138°59'W	4	6	0 SJ	5.0
3/4	1210	10°02'S	139°06'W	4	10	0 SJ	5.0
3/7	0900	09°10'S	140°00'W	5	11	0 SJ	4.0
3/7	0945	09°09'S	140°01'W	1	15	68 SJ	3.0
3/12	0937	14°44'S	146°39'W	1	17	87 SJ	15.0
3/13	0750	14°47'S	147°54'W	2	8	96 SJ	15.0
3/26	0625	10°11'S	139°33'W	2	4	0 SJ	3.0
3/28	0715	09°00'S	137°29'W	1	6	85 SJ	8.0
3/29	0712	08°46'S	139°45'W	2	5	0 SJ	2.0
3/29	0740	08°43'S	139°43'W	2	4	0 SJ	2.0
3/29	0810	08°42'S	139°42'W	2	4	0 SJ	1.0
3/29	1320	08°13'S	139°43'W	3	3	0 YF	1.0
3/29	1355	08°11'S	139°44'W	1	2	0 SJ	.5
3/29	1410	08°04'S	139°46'W	5	12	221 SJ	20.0
3/30	1205	05°51'S	139°38'W	1	6	0 SJ	5.0
3/31	1345	07°39'S	139°37'W	2	89	555 SJ	20.0
4/3	0950	09°08'S	140°16'W	1	2	0 ?	.5
4/3	1330	09°11'S	140°42'W	2	2	0 SJ	1.0
4/3	1550	09°10'S	140°50'W	1	3	0 SJ	1.0
4/6	0830	10°30'S	139°40'W	3	8	0 SJ and YF	4.0
4/11	1020	08°37'S	140°39'W	1	7	1 YF	4.0
4/11	1315	08°18'S	140°41'W	2	2	0 SJ	3.0
4/11	1450	08°12'S	140°40'W	2	7	72 SJ	10.0
4/12	1255	07°55'S	140°00'W	4	5	3 SJ	3.0
4/13	0740	08°21'S	139°34'W	2	2	0 ?	1.0
4/13	0950	08°31'S	139°33'W	2	2	0 ?	.5
4/13	1020	08°36'S	139°33'W	1	4	0 SJ	3.0
4/13	1335	08°51'S	139°31'W	3	3	0 SJ	3.0
4/14	0915	09°23'S	139°05'W	2	5	0 SJ	5.0
4/14	1020	09°06'S	139°01'W	1	3	0 SJ and YF	4.0
4/14	1205	09°34'S	138°54'W	1	1	0 ?	1.0
4/14	1325	09°46'S	138°47'W	3	10	0 SJ and YF	5.0
4/14	1514	09°49'S	138°50'W	1	1	0 SJ	1.0
4/15	0950	09°59'S	138°52'W	3	7	0 SJ and YF	4.0
4/15	1415	10°21'S	138°44'W	4	7	0 SJ	5.0
4/18	1045	09°32'S	139°52'W	6	33	216 SJ	20.0

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[1] SJ = skipjack, YF = yellowfin

Table 29.--Summary of pole-and-line fishing, Hugh M. Smith cruise 45

Date, 1958	Time, LT	Position		Number of passes	Number of minutes chummed	Number caught and species[1]	Amount of bait, buckets
		Latitude	Longitude				
5/15	0925	09°12'S	139°37'W	2	5	0 ?	1.0
5/16	0838	09°10'S	136°47'W	2	21	115 SJ	7.0
5/16	1540	09°10'S	136°06'W	2	10	123 SJ	8.0
5/20	0915	09°18'S	142°38'W	1	10	53 SJ	7.0
5/21	1310	09°14'S	141°13'W	1	5	30 SJ	4.0
5/21	1433	09°14'S	141°04'W	3	14	17 SJ	5.0
5/24	0652	06°31'S	139°39'W	2	9	31 SJ	6.0
5/24	1045	06°08'S	139°36'W	1	2	0 SJ	.5
5/24	1155	06°02'S	139°36'W	1	5	0 SJ	.5
5/24	1232	05°58'S	139°36'W	5	18	8 SJ	5.0
5/24	1622	05°37'S	139°38'W	2	3	0 SJ	1.0
5/24	1740	05°28'S	139°39'W	1	1	0 SJ	.5
5/25	0950	07°11'S	139°42'W	2	10	51 SJ	7.0
5/25	1420	07°42'S	139°40'W	1	20	105 SJ	6.0
5/28	1137	12°17'S	139°42'W	1	5	0 SJ	1.0
5/28	0942	12°08'S	139°42'W	1	2	21 SJ	2.0
5/28	1322	12°27'S	139°42'W	2	2	0 SJ	1.0
5/29	0955	11°10'S	139°44'W	1	5	11 SJ	2.0
5/29	1255	10°52'S	139°45'W	2	3	0 ?	3.0
5/29	1337	10°51'S	139°44'W	3	5	0 ?	2.0
5/29	1514	10°43'S	139°42'W	1	1	0 ?	1.0
5/29	1540	10°38'S	139°40'W	1	2	0 SJ	1.0
5/29	1615	10°34'S	139°38'W	1	2	0 ?	1.0
5/29	1630	10°31'S	139°37'W	3	8	0 ?	7.0
5/29	1714	10°28'S	139°36'W	1	1	0 SJ	2.0
6/1	0956	08°43'S	140°33'W	2	10	22 SJ	6.0
6/1	1521	08°09'S	140°43'W	7	13	0 SJ	6.0
6/2	0718	07°53'S	140°44'W	2	4	0 SJ	3.0
6/2	0952	07°45'S	140°29'W	2	3	0 [2]	1.0
6/2	1327	07°45'S	140°02'W	2	7	201 SJ	20.0
6/3	1110	08°38'S	139°22'W	5	13	0 SJ	4.5
6/7	1500	10°35'S	138°38'W	6	8	0 SJ	10.0

[1] SJ = skipjack

[2] School judged to be composed of "sun fish"

Table 30. --Pole-and-line caught skipjack and yellowfin length frequency by sex, Charles H. Gilbert cruise 35

Date, 1957	Latitude and Longitude	Sex	Species 1/	Fork length range in millimeters																																						Total
				405-414	415-424	425-434	435-444	445-454	455-464	465-474	475-484	485-494	495-504	505-514	515-524	525-534	535-544	545-554	555-564	565-574	575-584	585-594	595-604	605-614	615-624	625-634	635-644	645-654	655-664	665-674	675-684	685-694	695-704	705-714	715-724	725-734	735-744	745-754	755-764	765-774	775-784	
10/18	10°02'S	M	SJ	--	-	-	-	-	-	-	-	-	-	2	2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
	138°50'W	F	SJ	-	-	-	-	-	-	-	-	-	4	2	1	3	2	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
10/19	10°16'S	M	SJ	-	-	1	1	-	2	2	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
	138°56'W	F	SJ	-	-	-	-	3	3	1	2	1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
10/27	09°50'S	M	SJ	-	-	-	-	-	-	-	-	1	1	-	1	1	5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	139°34'W	F	SJ	-	-	-	-	-	-	1	-	-	2	-	1	3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
		M	YF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
		F	YF	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
11/3	07°32'S	M	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	7	-	1	2	15
	139°52'W	F	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	1	2	2	10
11/4	09°13'S	M	SJ	-	-	-	1	1	5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	140°43'W	F	SJ	-	-	2	4	2	1	3	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
11/6	09°16'S	M	SJ	-	-	-	-	2	3	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
	141°22'W	F	SJ	-	-	-	1	2	6	4	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
11/10	14°29'S	M	YF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
	146°05'W	?	YF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	6	4	2	3	3	-	-	-	-	-	-	-	-	-	-	-	24
11/11	14°33'S	M	SJ	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	146°07'W	F	SJ	-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
11/12	14°56'S	M	SJ	-	-	-	-	-	-	-	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
	147°38'W	F	SJ	-	-	-	-	-	-	4	7	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
11/19	15°37'S	M	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4	4	2	1	-	-	1	-	1	-	-	-	16
	147°25'W	F	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3	-	-	1	-	-	-	-	-	-	-	9
11/24	08°12'S	M	SJ	-	-	-	-	-	-	1	1	-	1	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
	140°41'W	F	SJ	-	-	-	-	-	-	1	4	1	4	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
11/24	08°12'S	M	SJ	-	1	-	-	1	4	2	2	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
	140°41'W	F	SJ	-	-	-	4	4	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
11/25	07°52'S	M	SJ	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	140°10'W	F	SJ	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
11/26	08°59'S	M	SJ	-	-	-	-	-	-	-	-	-	-	1	-	2	2	5	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	139°30'W	F	SJ	-	-	-	-	-	-	-	-	-	-	3	-	1	3	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
11/28	10°08'S	M	SJ	-	-	-	-	1	3	1	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
	138°50'W	F	SJ	-	-	-	-	3	5	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16

1/ SJ = Skipjack
YF = Yellowfin

Table 30.--Pole-and-line caught skipjack and yellowfin length frequency by sex, Charles H. Gilbert cruise 35 (cont'd)

Date, 1957	Latitude and Longitude	Sex	Species 1/	Fork length range in millimeters																																						Total
				405-414	415-424	425-434	435-444	445-454	455-464	465-474	475-484	485-494	495-504	505-514	515-524	525-534	535-544	545-554	555-564	565-574	575-584	585-594	595-604	605-614	615-624	625-634	635-644	645-654	655-664	665-674	675-684	685-694	695-704	705-714	715-724	725-734	735-744	745-754	755-764	765-774	775-784	
11/28	10°08'S	M	SJ	-	1	-	-	-	-	1	2	2	3	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	138°50'W	F	SJ	-	-	-	-	1	1	3	5	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
11/29	10°02'S	M	SJ	-	-	-	-	-	-	-	-	1	-	5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
	139°09'W	F	SJ	-	-	-	-	-	-	-	-	-	3	9	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
		?	YF	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Total	M	SJ	1	2	1	2	5	18	14	19	9	9	13	9	6	9	7	3	1	-	-	-	-	-	-	-	-	3	4	4	2	1	-	2	1	3	8	-	1	2	159
		F	SJ	-	-	2	9	15	18	20	28	10	19	21	8	9	8	6	7	1	-	-	-	-	-	-	-	-	-	5	3	-	-	1	-	1	3	1	1	2	2	200
		M	YF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2
		F	YF	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
		?	YF	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	3	-	3	6	4	2	3	3	-	-	-	-	-	-	-	-	-	-	-	26
	Total		SJ	1	2	3	11	20	36	34	47	19	28	34	17	15	17	13	10	2	-	-	-	-	-	-	-	-	3	9	7	2	1	1	2	2	6	9	1	3	4	359
			YF	-	-	-	-	-	-	-	-	-	-	1	1	2	1	2	-	-	1	-	3	-	3	6	4	2	4	3	-	-	-	-	-	-	-	-	-	-	-	33
	Grand total			1	2	3	11	20	36	34	47	19	28	35	18	17	18	15	10	2	1	-	3	-	3	6	4	2	7	12	7	2	1	1	2	2	6	9	1	3	4	392

1/ SJ = Skipjack
YF = Yellowfin

Table 31.--Pole-and-line caught skipjack and yellowfin length frequency by sex, Hugh M. Smith cruise 43

Date, 1958	Latitude and Longitude	Sex	Species[1]	Fork length range in millimeters																																		Total
				405-414	415-424	425-434	435-444	445-454	455-464	465-474	475-484	485-494	495-504	505-514	515-524	525-534	535-544	545-554	555-564	565-574	575-584	585-594	595-604	675-684	685-694	695-704	705-714	715-724	725-734	735-744	745-754	755-764	765-774	775-784	785-794	795-804	805-814	
1/18	08°34'S	M	SJ	1	-	4	3	2	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	140°38'W	F	SJ	-	-	2	2	3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
1/18	08°05'S	M	SJ	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	140°45'W	F	SJ	-	-	-	-	-	-	-	2	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
1/21	09°20'S	M	SJ	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	139°00'W	F	SJ	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
1/22	10°04'S	M	SJ	-	-	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	138°52'W	F	SJ	-	-	-	-	-	-	-	-	1	2	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
		M	YF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
1/25	09°09'S	M	SJ	-	-	-	-	3	-	6	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
	140°08'W	F	SJ	-	-	-	-	2	-	3	5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
1/28	09°18'S	M	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	4	4	2	1	1	1	-	-	15
	137°25'W	F	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	1	3	2	-	1	-	-	-	-	10
1/29	09°10'S	M	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	-	1	5	1	-	-	-	-	12
	136°30'W	F	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	3	1	4	3	-	-	-	-	-	-	13
1/30	09°08'S	M	SJ	-	-	-	-	-	1	1	2	1	1	1	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	139°38'W	F	SJ	-	-	-	-	-	1	1	-	3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
		?	YF	-	-	-	-	-	1	-	-	3	3	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
2/1	12°34'S	M	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	139°40'W	F	SJ	-	-	-	2	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
2/1	11°52'S	M	SJ	-	-	1	1	2	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	139°40'W	F	SJ	-	-	-	-	9	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
2/2	09°42'S	M	SJ	-	-	-	-	1	2	3	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
	139°40'W	F	SJ	-	-	-	-	1	3	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
2/7	09°12'S	M	SJ	-	-	-	3	4	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	141°16'W	F	SJ	-	-	1	4	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
2/9	09°00'S	M	SJ	-	-	-	1	-	3	5	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
	139°38'W	F	SJ	-	-	-	-	2	3	1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
2/10	06°00'S	M	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	1	4	3	-	2	14
	139°46'W	F	SJ	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	2	3	2	-	11
	Total	M	SJ	1	-	5	8	12	15	19	11	10	7	2	4	3	-	1	-	-	-	-	-	-	1	-	2	1	3	4	7	9	3	5	4	-	2	139
		F	SJ	-	-	3	8	23	18	11	16	12	8	4	3	1	1	-	-	-	-	-	-	1	-	1	2	4	2	7	8	1	1	2	3	2	-	142
		M	YF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
		?	YF	-	-	-	-	-	1	-	-	3	3	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	Total		SJ	1	-	8	16	35	33	30	27	22	15	6	7	4	1	1	-	-	-	-	-	1	1	1	4	5	5	11	15	10	4	7	7	2	2	281
			YF	-	-	-	-	-	1	-	-	3	3	1	1	1	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	Grand total			1	-	8	16	35	34	30	27	25	18	7	8	5	1	1	-	1	-	-	1	1	1	1	4	5	5	11	15	10	4	7	7	2	2	293

[1] SJ = Skipjack, YF = Yellowfin

Table 32.--Pole-and-line caught skipjack length frequency by sex, Charles H. Gilbert cruise 38

Date, 1958	Latitude and Longitude	Sex	Fork length range in millimeters																																		Total
			425-434	435-444	445-454	455-464	465-474	475-484	485-494	495-504	505-514	515-524	525-534	535-544	545-554	555-564	565-574	585-594	595-604	605-614	615-624	625-634	635-644	645-654	655-664	675-684	685-694	735-744	745-754	755-764	765-774	775-784	785-794	795-804	805-814	815-824	
2/27	08°50'S	M	-	-	-	-	-	-	1	1	1	5	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
	140°16'W	F	-	-	-	-	-	-	1	4	2	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
2/28	07°57'S	M	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	139°47'W	F	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
3/1	08°08'S	M	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	139°36'W	F	-	-	-	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
3/2	09°22'S	M	-	-	-	-	-	-	-	-	-	3	2	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
	139°02'W	F	-	-	-	-	-	-	1	-	-	2	1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
		?	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
3/3	10°01'S	M	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	138°52'W	F	-	-	-	-	-	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
		?	-	-	-	-	1	5	6	2	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
3/7	09°09'S	M	-	-	-	2	5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
	140°01'W	F	-	1	-	-	3	6	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
3/12	14°44'S	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	2	3	1	9
	146°39'W	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	2	6	2	1	-	-	16
3/13	14°48'S	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	4	2	-	3	-	-	1	-	-	-	-	-	-	-	-	-	14
	147°54'W	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	2	4	1	-	1	1	-	-	-	-	-	-	-	-	-	-	14
3/28	09°00'S	M	-	2	4	7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
	137°29'W	F	1	3	6	3	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19
3/29	08°04'S	M	-	-	-	2	1	3	2	1	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
	139°46'W	F	-	-	-	-	2	2	5	2	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
3/31	07°39'S	M	-	1	4	9	9	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28
	139°38'W	F	-	1	4	6	2	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
4/11	08°12'S	M	-	-	-	1	2	2	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	140°40'W	F	-	-	1	3	3	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
4/12	07°55'S	M	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	140°00'W	F	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
4/18	09°32'S	M	-	-	1	2	2	1	2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	139°52'W	F	-	-	2	4	3	4	1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
	Total	M	-	3	9	25	22	14	14	10	6	11	2	2	4	1	1	1	1	2	4	2	-	3	-	-	1	-	-	-	-	3	-	2	3	1	147
		F	2	5	13	17	21	23	16	11	6	9	2	6	-	-	-	1	3	1	2	4	1	-	1	1	-	1	3	1	2	6	2	1	-	-	161
		?	-	-	-	-	1	5	6	2	5	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24
	Grand total		2	8	22	42	44	42	36	23	17	23	4	9	4	2	1	2	4	3	6	6	1	3	1	1	1	1	3	1	2	9	2	3	3	1	332

Table 33.--Pole-and-line caught yellowfin length frequency by sex, Charles H. Gilbert cruise 38

Date, 1958	Latitude and Longitude	Sex	Fork length range in millimeters																		Total
			485-494	505-514	575-584	605-614	645-654	655-664	695-704	705-714	715-724	725-734	735-744	745-754	755-764	765-774	775-784	795-804	885-894	915-924	
2/27	08°50'S	M	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
	140°16'W	F	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-	-	3
2/28	07°57'S	M	-	-	-	-	-	-	1	1	-	1	1	-	-	2	-	-	-	1	7
	139°47'W	F	-	-	-	-	-	-	-	1	1	1	1	1	-	1	-	-	1	-	7
3/29	08°04'S	M	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
	139°46'W	F	-	1	-	-	-	1	1	-	-	-	1	1	-	-	1	1	-	-	7
4/11	08°12'S	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
	140°40'W	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4/18	09°32'S	M	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	139°52'W	F	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Total	M	1	-	-	-	1	-	1	1	-	1	1	2	1	2	-	1	-	1	13
		F	-	1	1	1	-	1	1	1	2	1	2	3	-	2	1	1	1	-	19
	Grand total		1	1	1	1	1	1	2	2	2	2	3	5	1	4	1	2	1	1	32

Table 34. --Pole-and-line caught skipjack length frequency by sex, Hugh M. Smith cruise 45

Date, 1958	Latitude	Longitude	Sex	Fork length range in millimeters																																				Total
				385-394	405-414	415-424	425-434	435-444	445-454	455-464	465-474	475-484	485-494	495-504	505-514	515-524	525-534	535-544	545-554	575-584	585-594	595-604	655-664	665-674	675-684	685-694	695-704	705-714	715-724	725-734	735-744	745-754	755-764	765-774	775-784	785-794	795-804	805-814	825-834	
5/16	09°10'S	136°06'W	M	-	-	-	-	-	-	-	-	1	1	1	2	2	2	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
			F	1	-	-	-	-	1	-	2	1	2	1	-	-	2	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
5/16	09°10'S	136°47'W	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	4	3	3	2	-	-	-	-	-	-	1	16
			F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	2	1	2	1	-	-	-	-	-	-	9
5/20	09°18'S	142°38'W	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	2	-	1	-	-	-	-	-	-	-	-	-	-	6
			F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-	7
5/21	09°14'S	141°13'W	M	-	-	-	-	-	-	-	3	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
			F	-	-	-	-	-	1	4	3	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
5/21	09°14'S	141°04'W	M	-	-	-	-	-	1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
			F	-	-	-	-	-	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
5/24	06°31'S	139°39'W	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	4	2	2	2	1	-	-	13
			F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	1	-	1	-	-	5
5/24	05°58'S	139°36'W	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
			F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3	1	-	-	-	2	-	7
5/25	07°11'S	139°42'W	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	1	3	-	1	1	1	-	-	-	11
			F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	2	3	2	2	1	1	-	14
5/25	07°42'S	139°40'W	M	-	-	1	1	-	-	3	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
			F	-	-	-	-	1	1	7	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15
5/28	12°08'S	139°42'W	M	-	1	-	-	-	-	1	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
			F	-	-	-	-	-	1	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
5/29	11°10'S	139°44'W	M	-	-	-	-	-	-	1	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
			F	-	-	-	-	-	-	1	1	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
6/1	08°43'S	140°33'W	M	-	-	-	-	-	1	4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
			F	-	-	-	-	-	3	4	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
6/2	07°45'S	140°02'W	M	-	-	-	-	-	-	-	-	-	1	-	4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
			F	-	-	-	-	-	-	-	-	-	-	4	5	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
		Total	M	-	1	1	1	-	2	11	13	11	9	1	7	5	5	3	1	-	-	1	-	-	1	2	4	2	5	6	5	6	4	3	3	3	2	-	1	119
			F	1	-	-	-	1	9	20	18	7	5	7	5	3	4	-	1	1	1	-	1	2	1	3	-	2	1	3	4	3	6	6	3	2	2	3	-	125
		Grand total		1	1	1	1	1	11	31	31	18	14	8	12	8	9	3	2	1	1	1	1	2	2	5	4	4	6	9	9	9	10	9	6	5	4	3	1	244

Table 35.--Summary of bait fishing for Marquesan sardines, *Charles H. Gilbert* cruise 35

Date, 1957	Locality	Amount seen per day, buckets	Number of sets		Catch, buckets
			Day	Night	
10/13	Taiohae, Nuku Hiva	-	4	-	100
10/23	Taiohae, Nuku Hiva	-	3	-	48
10/30	Taiohae, Nuku Hiva	-	2	-	58
11/7	Taiohae, Nuku Hiva	-	6	-	75
11/23	Taiohae, Nuku Hiva	-	3	-	158
11/28	Taa Huku, Hiva Oa	-	1	-	15
11/28	Hana Tetou, Tahu Ata	-	2	-	0
11/29	Taa Huku, Hiva Oa	-	1	-	2
12/2	Taiohae, Nuku Hiva	-	3	-	100
	Total		25	-	556

Table 36.--Summary of bait fishing for Marquesan sardines, *Hugh M. Smith* cruise 43

Date, 1958	Locality	Amount seen per day, buckets	Number of sets		Catch, buckets
			Day	Night	
1/15	Taiohae, Nuku Hiva	36-41	3	-	17
1/15	Taiohae, Nuku Hiva	-	-	1	0
1/16	Taiohae, Nuku Hiva	-	-	1	4
1/16	Taiohae, Nuku Hiva	3-4	1	-	Handful
1/16	Hanga Haa, Nuku Hiva	0	-	-	-
1/17	Anaho, Nuku Hiva	0	-	-	-
1/17	Tai Oa, Nuku Hiva	65	6	-	98
1/20	Hananai, Ua Huka	-	-	1	30
1/21	Taa Huku, Hiva Oa	-	-	1	18
1/22	Taa Huku, Hiva Oa	-	2	-	29
1/25	Haka Nai, Hua Pou	11	-	-	-
1/25	Tai Oa, Nuku Hiva	-	3	-	101
1/26	Taiohae, Nuku Hiva	40	4	-	81
1/27	Hanga Haa, Nuku Hiva	0	-	-	-
1/27	Haka Puuae, Nuku Hiva	0	-	-	-
1/27	Houmi, Nuku Hiva	50	-	-	-
1/27	Anaho, Nuku Hiva	0	-	-	-
1/27	Hatiheu, Nuku Hiva	0	-	-	-
2/2	Taiohae, Nuku Hiva	-	-	1	1
2/3	Taiohae, Nuku Hiva	157	6	-	56
2/3	Tai Oa, Nuku Hiva	0	2	-	1
2/4	Houmi, Nuku Hiva	0	-	-	-
2/4	Hanga Haa, Nuku Hiva	33	6	-	39
2/4	Haka Puuae, Nuku Hiva	-	2	-	14
2/4	Taiohae, Nuku Hiva	0	-	-	-
2/8	Hananai, Ua Huka	25	-	-	-
2/8	Hananai, Ua Huka	0	-	-	-
2/8	Vai Take, Ua Huka	0	-	-	-
2/12	Anaho, Nuku Hiva	0	-	-	-
2/12	Taiohae, Nuku Hiva	19	2	-	16
2/12	Taiohae, Nuku Hiva	20	-	2	17
2/13	Taiohae, Nuku Hiva	187	9	-	184
2/14	Taiohae, Nuku Hiva	21	3	-	4
2/14	Tai Oa, Nuku Hiva	0	3	-	4
2/14	Taiohae, Nuku Hiva	0	1	-	8
	Total		53	7	722

Table 37.--Summary of bait fishing for Marquesan sardines, Charles H. Gilbert cruise 38

Date, 1958	Locality	Amount seen per day, buckets	Number of sets		Catch, buckets
			Day	Night	
2/26	Taiohae, Nuku Hiva	15	5	-	25
2/26	Hakaui, Nuku Hiva	-	4	-	55
3/1	Hananai, Ua Huka	0	-	-	-
3/3	Taa Huku, Hiva Oa	0	1	-	0
3/3	Hana Tetou, Tahu Ata	-	1	-	41.5
3/4	Hana Tetou, Tahu Ata	0	-	-	-
3/5	Vai Tahu, Tahu Ata	0	-	-	-
3/8	Taiohae, Nuku Hiva	Scattered	8	-	25.5
3/8	Hakatea, Nuku Hiva	0	-	-	-
3/8	Hakaui, Nuku Hiva	Scattered	1	-	7
3/9	Taiohae, Nuku Hiva	0	1	-	0
3/9	Hanga Haa, Nuku Hiva	0	1	-	0
3/9	Haka Puuae, Nuku Hiva	0	-	-	-
3/9	Houmi, Nuku Hiva	0	-	-	-
3/9	Taiohae, Nuku Hiva	0	-	-	-
3/9	Hakaui, Nuku Hiva	-	1	-	4
3/23	Taiohae, Nuku Hiva	-	-	1	Few
3/24	Taiohae, Nuku Hiva	0	4	-	17
3/24	Hakatea, Nuku Hiva	0	-	-	-
3/24	Hakaui, Nuku Hiva	0	-	-	-
3/24	Bay Marquisienne, Nuku Hiva	0	-	-	-
3/25	Taiohae, Nuku Hiva	-	9	-	30.5
4/1	Hataivea, Nuku Hiva	0	-	-	-
4/1	Anaho, Nuku Hiva	0	-	-	-
4/1	Hatiheu, Nuku Hiva	0	-	-	-
4/2	Taiohae, Nuku Hiva	0	-	-	-
4/2	Hakatea, Nuku Hiva	0	2	-	9
4/2	Hakaui, Nuku Hiva	0	-	-	-
4/2	Taiohae, Nuku Hiva	-	-	2	4
4/9	Hanga Haa, Nuku Hiva	0	3	-	7
4/9	Haka Puuae, Nuku Hiva	0	-	-	-
4/9	Taiohae, Nuku Hiva	0	-	-	-
4/10	Taiohae, Nuku Hiva	Scattered	8	-	83
4/13	Hananai, Ua Huka	0	-	-	-
4/13	Hananai, Ua Huka	0	-	-	-
4/15	Motopu, Tahu Ata	0	-	-	-
4/15	Hana Tetou, Tahu Ata	-	2	-	43
4/16	Vai Tahu, Tahu Ata	0	-	-	-
4/19	Taiohae, Nuku Hiva	0	1	-	23
4/19	Hakaui, Nuku Hiva	0	-	-	-
4/19	Hakatea, Nuku Hiva	Scattered	2	-	42
4/20	Taiohae, Nuku Hiva	Scattered	3	-	34
	Total		57	3	450.5

Table 38.--Summary of bait fishing for Marquesan sardines, Hugh M. Smith cruise 45

Date, 1958	Locality	Amount seen per day, buckets	Number of sets		Catch, buckets
			Day	Night	
5/12	Taiohae, Nuku Hiva	-	4	-	35.0
5/12	Tai Oa, Nuku Hiva	-	3	-	5.0
5/13	Hanga Haa, and Haka Puuae, Nuku Hiva	-	6	-	17.0
5/14	Taiohae, Nuku Hiva	-	3	-	35.0
5/18	Taiohae, Nuku Hiva	-	4	-	15.0
5/18	Tai Oa, Nuku Hiva	-	3	-	26.5
5/22	Tai Oa, Nuku Hiva	-	4	-	21.5
5/22	Taiohae, Nuku Hiva	-	5	-	38.0
5/26	Taiohae, Nuku Hiva	-	6	-	22.5
5/31	Taiohae, Nuku Hiva	-	7	-	51.0
6/4	Taiohae, Nuku Hiva	-	1	-	0.0
6/6	Taa Huku, Hiva Oa	-	2	-	10.0
6/6	Hana Menu, Hiva Oa	-	2	-	4.0
6/11	Tai Oa, Nuku Hiva	-	1	-	0.0
6/11	Hanga Haa, Nuku Hiva	-	4	-	20.0
6/12	Taiohae, Nuku Hiva	-	1	-	1.0
	Total	-	56	-	301.5

Table 39. --Marquesan sardine length frequency by sex, Charles H. Gilbert cruise 35

Date, 1957	Position		Sex	Fork length range in millimeters										Total
	Latitude	Longitude		35-44	45-54	55-64	65-74	75-84	85-94	95-104	105-114	115-124	125-134	
10/13	08°56'S	140°05'W	M	-	-	-	-	-	-	6	2	-	-	8
			F	-	-	-	-	-	-	8	7	3	-	18
10/13	08°56'S	140°05'W	M	-	-	-	-	-	-	2	3	1	-	6
			F	-	-	-	-	-	-	2	14	1	1	18
			?	-	-	-	-	-	-	1	-	-	-	1
10/13	08°56'S	140°05'W	M	-	-	-	-	-	-	6	2	2	-	10
			F	-	-	-	-	-	-	12	5	2	1	20
10/13	08°56'S	140°05'W	M	-	-	-	-	-	3	8	1	-	-	12
			F	-	-	-	-	-	-	6	7	-	-	13
10/23	08°56'S	140°05'W	M	-	-	-	-	-	4	7	2	1	-	14
			F	-	-	-	-	-	-	8	4	-	-	12
10/23	08°56'S	140°05'W	M	-	-	-	-	-	-	8	1	-	-	9
			F	-	-	-	-	-	-	5	11	-	-	16
10/23	08°56'S	140°05'W	M	-	-	-	-	-	1	4	-	-	-	5
			F	-	-	-	-	-	1	6	2	-	-	9
10/30	08°56'S	140°05'W	M	-	-	-	-	-	5	6	2	-	-	13
			F	-	-	-	-	-	2	9	1	-	-	12
10/30	08°56'S	140°05'W	M	-	-	-	-	-	9	9	1	-	-	19
			F	-	-	-	-	-	-	6	-	-	-	6
11/7	08°56'S	140°05'W	M	-	-	-	-	-	6	14	-	-	-	20
			F	-	-	-	-	-	-	5	-	-	-	5
11/7	08°56'S	140°05'W	M	-	-	-	-	3	2	2	2	-	-	9
			F	-	-	-	-	-	1	10	1	-	-	12
11/23	08°56'S	140°05'W	M	-	-	-	-	2	11	10	-	-	-	23
			F	-	-	-	-	-	-	-	2	-	-	2
11/23	08°56'S	140°05'W	M	-	-	-	-	-	5	12	3	-	-	20
			F	-	-	-	-	-	-	3	1	1	-	5
11/23	08°56'S	140°05'W	M	-	-	-	-	1	7	10	-	-	-	18
			F	-	-	-	-	-	-	6	1	-	-	7
11/28	09°48'S	139°02'W	M	-	-	-	-	3	7	3	-	-	-	13
			F	-	-	-	-	-	2	-	1	-	-	3
			?	1	-	3	4	1	-	-	-	-	-	9
11/29	09°48'S	139°02'W	M	-	-	-	-	-	-	-	-	-	-	-
			F	-	-	-	-	-	1	-	1	-	-	2
			?	-	-	1	21	1	-	-	-	-	-	23
12/2	08°56'S	140°05'W	M	-	-	-	-	-	4	11	1	-	-	16
			F	-	-	-	-	-	1	6	-	1	-	8
			?	-	-	1	-	-	-	-	-	-	-	1
12/2	08°56'S	140°05'W	M	-	-	-	-	-	2	15	1	-	-	18
			F	-	-	-	-	-	-	5	2	-	-	7
	Total		M	-	-	-	-	9	66	133	21	4	-	233
			F	-	-	-	-	-	8	97	60	8	2	175
			?	1	-	5	25	2	-	1	-	-	-	34
	Grand total			1	-	5	25	11	74	231	81	12	2	442

Table 40. --Marquesan sardine length frequency by sex, Hugh M. Smith cruise 43

Date, 1958	Position		Sex	Fork length range in millimeters							Total
	Latitude	Longitude		65-74	75-84	85-94	95-104	105-114	115-124	125-134	
1/22	09°48'S	139°02'W	M	-	-	-	-	-	-	-	-
			F	-	-	-	3	-	-	-	3
			?	-	-	1	-	-	-	-	1
1/25	08°58'S	140°10'W	M	-	2	-	11	1	-	-	14
			F	-	-	1	4	2	-	-	7
			?	3	1	-	-	-	-	-	4
1/26	08°56'S	140°05'W	M	-	1	1	11	2	-	-	15
			F	-	-	-	1	7	-	-	8
			?	-	1	1	-	-	-	-	2
2/3	08°56'S	140°05'W	M	-	-	1	3	1	-	-	5
			F	-	-	-	-	4	2	-	6
			?	-	1	-	-	-	-	-	1
2/3	08°56'S	140°05'W	M	-	2	2	10	-	-	-	14
			F	-	1	-	2	4	1	-	8
			?	-	3	-	-	-	-	-	3
2/4	08°54'S	140°02'W	M	-	-	2	6	1	-	-	9
			F	-	-	-	3	10	2	-	15
			?	-	1	-	-	-	-	-	1
2/4	08°54'S	140°02'W	M	-	-	2	1	-	-	-	3
			F	-	-	-	6	12	4	-	22
2/4	08°54'S	140°02'W	M	-	-	10	7	-	-	-	17
			F	-	-	-	4	3	1	-	8
2/12	08°56'S	140°05'W	M	1	6	6	3	1	-	-	17
			F	1	2	3	-	-	1	-	7
			?	1	-	-	-	-	-	-	1
2/12	08°56'S	140°05'W	M	-	5	5	-	1	-	-	11
			F	-	-	1	-	4	-	-	5
2/13	08°56'S	140°05'W	M	1	1	3	-	2	-	-	7
			F	-	1	2	1	2	-	-	6
			?	-	2	-	-	-	-	-	2
2/13	08°56'S	140°05'W	M	-	-	1	5	5	1	-	12
			F	-	-	2	-	4	3	-	9
2/13	08°56'S	140°05'W	M	-	1	4	5	3	-	-	13
			F	-	-	2	3	4	2	1	12
2/13	08°56'S	140°05'W	M	-	-	-	11	1	-	-	12
			F	-	-	1	1	9	1	1	13
2/13	08°56'S	140°05'W	M	-	3	4	7	1	-	-	15
			F	1	1	1	1	6	-	-	10
2/13	08°56'S	140°05'W	M	-	-	1	15	5	-	-	21
			F	-	-	-	1	3	-	-	4
		Total	M	2	21	42	95	24	1	-	185
			F	2	5	13	30	74	17	2	143
			?	4	9	2	-	-	-	-	15
		Grand total		8	35	57	125	98	18	2	343

Table 41.--Marquesan sardine length frequency by sex, Charles H. Gilbert cruise 38

Date, 1958	Position		Sex	Fork length range in millimeters									Total
	Latitude	Longitude		45-54	55-64	65-74	75-84	85-94	95-104	105-114	115-124	125-134	
2/26	08°56'S	140°05'W	M	-	-	-	-	3	15	4	-	-	22
			F	-	-	-	-	-	3	-	1	-	4
2/26	08°58'S	140°09'W	M	-	-	-	2	3	4	3	-	-	12
			F	-	-	-	1	5	2	1	1	-	10
			?	-	-	-	3	-	-	-	-	-	3
2/26	08°58'S	140°09'W	M	-	-	-	2	3	2	4	1	-	12
			F	-	-	-	4	4	-	1	2	2	13
3/3	09°54'S	139°05'W	M	-	-	-	1	2	5	5	-	-	13
			F	-	-	-	-	-	5	7	-	-	12
3/8	08°56'S	140°05'W	M	-	-	-	3	9	1	1	-	-	14
			F	-	-	-	3	5	-	2	-	-	10
			?	-	-	1	-	-	-	-	-	-	1
3/8	08°58'S	140°09'W	M	-	-	-	-	3	6	5	-	-	14
			F	-	-	-	-	4	3	2	2	-	11
3/25	08°56'S	140°05'W	M	-	-	-	-	3	2	-	-	-	5
			F	-	-	-	-	-	4	1	2	-	7
4/10	08°56'S	140°06'W	M	-	-	-	-	6	3	-	-	-	9
			F	-	-	-	-	2	4	-	-	-	6
4/19	08°56'S	140°06'W	M	-	-	-	-	1	13	5	-	-	19
			F	-	-	-	-	2	3	1	-	-	6
4/19	08°58'S	140°09'W	M	-	-	-	-	-	2	8	1	1	12
			F	-	-	-	-	1	2	5	1	1	10
			?	1	1	1	-	-	-	-	-	-	3
	Total		M	-	-	-	8	33	53	35	2	1	132
			F	-	-	-	8	23	26	20	9	3	89
			?	1	1	2	3	-	-	-	-	-	7
	Grand total			1	1	2	19	56	79	55	11	4	228

Table 42.--Marquesan sardine length frequency by sex, Hugh M. Smith cruise 45

Date, 1958	Position		Sex	Fork length range in millimeters									Total
	Latitude	Longitude		35-44	45-54	55-64	65-74	75-84	85-94	95-104	105-114	115-124	
5/12	08°56'S	140°05'W	M	-	-	-	-	3	6	9	1	-	19
			F	-	-	-	-	2	2	2	-	-	6
5/12	08°56'S	140°06'W	M	-	-	-	3	11	4	1	-	-	19
			F	-	-	1	-	2	2	-	-	-	5
			?	-	-	-	1	-	-	-	-	-	1
5/12	08°56'S	140°06'W	M	-	-	-	2	11	1	-	-	-	14
			F	-	-	-	2	2	5	1	1	-	11
5/12	08°58'S	140°09'W	M	-	1	1	-	-	-	-	-	-	2
			F	-	1	5	-	-	-	-	-	-	6
			?	1	8	8	-	-	-	-	-	-	17
5/13	08°54'S	140°02'W	M	-	-	-	-	-	2	1	-	-	3
			F	-	-	-	-	-	3	9	3	4	19
5/13	08°54'S	140°02'W	M	-	-	-	-	2	2	3	-	-	7
			F	-	-	-	-	-	8	3	2	-	13
5/13	08°55'S	140°02'W	M	-	-	-	-	-	5	4	-	-	9
			F	-	-	-	-	-	1	5	10	-	16
5/18	08°58'S	140°09'W	M	-	-	-	-	1	6	7	2	-	16
			F	-	-	-	3	-	1	3	2	-	9
5/22	08°58'S	140°09'W	M	-	-	-	-	1	3	2	1	-	7
			F	-	-	-	1	2	6	2	-	1	12
			?	-	-	-	1	4	-	-	-	-	5
6/11	08°54'S	140°02'W	M	-	-	-	-	-	3	3	2	-	8
			F	-	-	-	-	-	3	8	6	-	17
6/12	08°56'S	140°06'W	M	-	-	-	-	1	1	13	-	-	15
			F	-	-	-	-	-	-	3	5	2	10
		Total	M	-	1	1	5	30	33	43	6	-	119
			F	-	1	6	6	8	31	36	29	7	124
			?	1	8	8	2	4	-	-	-	-	23
		Grand total		1	10	15	13	42	64	79	35	7	266

Table 43.--Record of daily sightings of bird flocks, scattered birds, and tuna schools, Charles H. Gilbert cruise 35

Date, 1957	Noon position		Flocks										Scattered birds								Tuna schools			
				Size			Composition																	
	Latitude	Longitude	Total number	< 10	10 - 50	> 50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified	Little tuna
10/3	19°10'N	156°00'W	2	-	1	1	2	-	-	-	2	-	-	12	-	8	-	-	-	-	-	1	1	-
10/4	16°11'N	154°14'W	-	-	-	-	-	-	-	-	-	-	-	23	-	14	-	2	-	-	-	-	-	-
10/5	13°12'N	152°24'W	1	1	-	-	1	-	-	-	-	-	-	14	-	10	-	2	-	-	-	-	-	-
10/6	10°08'N	150°34'W	1	-	1	-	-	-	-	-	1	-	-	23	-	-	-	-	-	2	-	-	-	-
10/7	07°12'N	148°44'W	-	-	-	-	-	-	-	-	-	-	-	29	1	-	-	2	-	-	-	-	-	-
10/8	04°35'N	147°02'W	-	-	-	-	-	-	-	-	-	-	-	12	6	-	-	2	1	-	-	-	-	-
10/9	01°43'N	145°33'W	1	1	-	-	1	-	-	-	1	-	-	13	4	-	-	1	1	-	-	-	-	-
10/10	01°14'S	143°42'W	2	1	-	1	1	-	-	1	1	-	-	8	1	20	-	1	14	-	-	-	-	-
10/11	04°32'S	142°35'W	-	-	-	-	-	-	-	-	-	-	-	9	3	9	2	2	-	-	-	2	-	-
10/12	07°23'S	141°06'W	23	-	11	12	20	18	1	3	16	19	-	-	12	20	-	1	-	1	-	4	-	1
10/14	08°22'S	140°33'W	14	1	8	5	10	9	-	5	3	-	-	9	11	111	11	-	1	8	1	1	-	-
10/15	07°48'S	139°56'W	5	1	3	1	3	2	-	1	-	3	-	38	47	61	11	-	-	24	1	-	-	-
10/16	08°44'S	139°20'W	10	-	5	5	10	8	3	9	6	1	-	20	3	10	3	-	-	21	-	-	-	-
10/17	09°38'S	138°50'W	9	-	4	5	5	3	-	-	4	2	-	17	16	56	7	-	2	27	-	1	-	-
10/18	10°20'S	138°28'W	10	3	-	7	6	5	-	1	4	-	-	4	11	26	2	-	-	-	3	1	-	-
10/19	09°57'S	139°08'W	8	-	4	4	5	5	-	3	5	-	-	12	8	59	3	-	-	-	-	3	1	-
10/20	09°29'S	140°02'W	9	4	3	2	7	5	-	4	7	-	-	14	9	62	5	-	-	11	-	-	2	-
10/21	09°34'S	139°50'W	2	-	1	1	1	-	-	-	1	-	-	5	-	1	-	-	-	-	-	-	1	-
10/22	Taiohae,	Nuku Hiva	3	2	1	-	1	1	-	-	1	-	-	8	4	11	2	-	-	-	-	-	-	-
10/24	09°07'S	139°04'W	11	1	7	3	9	9	-	3	9	-	-	18	15	27	1	-	-	-	-	1	1	-
10/25	09°16'S	136°15'W	3	1	2	-	2	1	-	2	-	1	-	5	2	8	11	-	-	-	-	-	-	-
10/26	09°13'S	137°44'W	4	1	2	1	3	-	-	1	3	-	-	24	3	50	7	1	1	5	1	1	-	-
10/27	09°56'S	139°33'W	9	-	4	5	5	3	-	2	4	2	-	14	3	20	-	-	-	-	1	3	-	-
10/28	09°27'S	139°32'W	3	1	2	-	1	-	-	-	1	-	-	1	-	37	-	-	2	-	-	-	-	-
10/29	11°14'S	139°25'W	2	1	1	-	-	-	-	-	-	-	-	23	2	61	-	-	5	-	-	-	-	-
10/30	08°56'S	140°05'W	2	-	2	-	2	-	-	-	1	1	-	1	1	7	-	-	-	-	-	-	-	-
11/1	08°20'S	139°35'W	5	-	2	3	3	3	-	1	3	-	-	31	3	26	4	2	-	8	-	-	1	-
11/2	06°05'S	139°39'W	4	1	2	1	4	2	-	2	-	4	-	11	1	6	2	-	-	-	-	-	-	-
11/3	07°24'S	139°49'W	11	2	4	5	9	8	-	4	3	7	-	2	3	12	2	-	-	-	-	4	-	-
11/4	09°13'S	140°27'W	14	1	11	2	14	4	-	5	8	10	-	18	6	32	1	-	-	33	-	-	-	-
11/5	09°11'S	143°11'W	1	1	-	-	-	-	-	-	-	1	-	14	-	27	4	1	-	-	-	-	-	-
11/6	09°15'S	141°23'W	12	-	10	2	11	6	-	-	11	9	-	16	-	36	10	-	-	-	1	1	1	-
11/8	09°47'S	141°07'W	12	2	10	-	12	2	-	2	4	9	-	11	3	8	-	1	-	1	-	-	-	-
11/9	12°31'S	143°32'W	1	1	-	-	-	-	-	-	-	1	-	11	-	8	6	1	-	-	-	-	-	-
11/10	14°29'S	146°05'W	7	-	6	1	3	-	-	1	6	6	-	8	-	16	-	-	-	19	-	-	-	-
11/11	14°43'S	146°55'W	8	1	5	2	5	-	-	1	6	3	-	8	-	66	2	1	-	3	-	1	-	-
11/12	15°07'S	148°12'W	5	-	1	4	5	5	-	1	5	-	-	55	9	48	1	-	-	-	-	2	-	-
11/13	15°38'S	148°10'W	2	2	-	-	2	1	-	-	-	-	2	5	16	27	-	-	-	-	-	-	-	-
11/18	17°30'S	149°35'W	-	-	-	-	-	-	-	-	-	-	-	3	2	3	-	-	-	-	-	-	-	-
11/19	15°30'S	147°17'W	15	-	1	14	4	15	-	14	13	12	-	5	35	13	2	1	-	8	-	4	1	-
11/20	13°40'S	144°40'W	7	1	2	4	7	5	-	2	7	5	-	19	2	17	-	-	-	-	-	-	1	-
11/21	11°22'S	142°24'W	6	2	2	2	3	1	-	3	5	4	-	5	3	34	2	-	-	-	-	2	-	-
11/22	09°04'S	140°12'W	13	1	7	5	13	6	-	-	7	7	-	8	3	17	-	-	-	-	1	3	4	-
11/24	08°17'S	140°39'W	13	-	5	8	12	11	-	6	9	2	-	33	13	84	7	-	-	22	-	2	1	-
11/25	07°56'S	140°01'W	8	-	2	6	4	4	-	3	4	2	-	20	16	25	24	-	-	4	-	-	1	-

Table 43.--Record of daily sightings of bird flocks, scattered birds, and tuna schools, Charles H. Gilbert cruise 35 (cont'd)

Date, 1957	Noon position		Flocks										Scattered birds								Tuna schools			
				Size			Composition																	
	Latitude	Longitude	Total number	< 10	10 - 50	> 50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified	Little tuna
11/26	08°53'S	139°19'W	13	-	10	3	13	12	-	4	10	2	-	15	10	31	5	-	3	-	-	1	-	-
11/27	09°43'S	138°46'W	10	1	3	6	9	7	-	2	1	5	-	10	1	27	-	-	-	10	-	1	-	-
11/28	10°03'S	138°49'W	13	-	3	10	11	5	-	3	5	10	-	3	4	1	2	-	-	-	-	-	1	-
11/29	09°53'S	139°05'W	15	1	8	6	14	6	-	2	9	12	-	5	2	16	3	-	-	8	-	2	4	-
11/30	09°36'S	139°45'W	11	1	5	5	7	6	1	3	7	8	-	18	1	47	1	-	-	11	-	-	-	-
12/1	09°33'S	139°49'W	8	-	4	4	7	3	1	-	7	7	-	6	-	11	-	-	-	2	-	2	1	-
12/2	09°05'S	140°05'W	1	-	-	1	1	-	-	-	1	-	-	4	2	11	-	-	-	7	-	1	-	-
12/4	07°22'S	140°58'W	9	-	2	7	9	6	1	6	9	-	-	8	5	28	2	1	-	8	-	-	2	-
12/5	04°25'S	142°49'W	5	-	2	3	4	2	-	2	5	-	-	11	3	3	8	2	-	-	-	-	-	-
12/6	01°17'S	144°08'W	4	1	3	-	4	-	-	-	2	-	-	22	1	2	-	-	1	-	-	-	-	-
12/7	01°37'N	145°44'W	13	1	5	7	13	3	-	-	11	2	-	18	10	7	-	1	-	1	-	-	5	-
12/8	04°35'N	147°44'W	9	-	5	4	8	3	1	-	9	-	-	19	1	35	-	3	-	-	-	-	3	-
12/9	07°35'N	149°12'W	2	-	-	2	2	-	-	-	2	1	-	28	1	-	-	-	1	-	-	1	1	-
12/10	10°42'N	151°08'W	-	-	-	-	-	-	-	-	-	-	1	1	-	1	-	3	15	-	-	-	-	-
12/11	13°35'N	153°19'W	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	1	2	-	-	-	-	-
12/12	16°34'N	155°07'W	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
12/13	19°40'N	156°06'W	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-	-	-	-	-	-	-
		Total	391	39	182	170	308	195	8	102	239	158	9	810	318	1,414	153	32	49	244	9	45	33	1

Table 44.--Record of daily sightings of bird flocks, scattered birds, and tuna schools, *Hugh M. Smith* cruise 43

Date, 1958	Noon position		Flocks										Scattered birds								Tuna schools		
			Total number	Size			Composition																
	Latitude	Longitude		< 10	10 - 50	> 50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified
1/3	21°26'N	158°24'W	-	-	-	-	-	-	-	-	-	-	15	-	2	-	-	-	-	-	-	-	-
1/4	22°02'N	157°56'W	-	-	-	-	-	-	-	-	-	-	5	1	20	-	-	-	1	-	-	-	-
1/5	18°58'N	156°16'W	-	-	-	-	-	-	-	-	-	-	11	-	3	-	-	-	3	-	-	-	-
1/6	16°03'N	154°30'W	-	-	-	-	-	-	-	-	-	-	11	-	-	1	-	1	2	-	-	-	-
1/7	13°13'N	152°40'W	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	1	-	-	-	-
1/8	10°20'N	151°18'W	-	-	-	-	-	-	-	-	-	-	-	11	-	50	-	3	3	-	-	-	-
1/9	07°39'N	149°32'W	-	-	-	-	-	-	-	-	-	-	-	20	1	4	-	-	2	-	-	-	-
1/10	04°56'N	147°54'W	1	-	1	-	1	-	-	-	1	-	-	18	3	6	-	5	11	-	-	-	-
1/11	02°15'N	146°18'W	13	1	12	-	13	3	-	-	3	-	-	4	29	134	8	1	1	-	-	-	1
1/12	00°35'S	145°05'W	12	-	9	3	10	4	1	3	4	-	-	-	19	152	1	1	6	-	-	-	4
1/13	03°30'S	143°29'W	1	-	-	1	1	-	-	1	1	-	1	-	6	40	2	3	-	1	-	-	1
1/14	06°30'S	141°40'W	6	-	6	-	5	4	-	3	5	-	-	8	9	4	-	1	4	-	-	1	5
1/18	08°30'S	140°40'W	10	-	1	9	10	7	-	-	9	-	-	11	29	142	6	10	17	-	-	7	3
1/19	07°51'S	140°14'W	13	-	3	10	12	11	-	8	7	-	-	26	24	137	15	-	1	-	-	3	10
1/20	08°52'S	139°04'W	10	-	4	6	10	7	-	-	2	-	-	8	11	111	5	1	20	-	-	1	8
1/21	09°26'S	138°56'W	16	-	4	12	17	9	-	6	10	-	-	99	62	171	14	1	8	-	2	8	7
1/22	10°05'S	138°50'W	17	-	8	9	14	7	-	8	9	-	-	49	79	246	60	-	23	-	4	6	8
1/23	10°00'S	139°24'W	5	1	3	1	5	-	-	-	-	-	-	25	8	79	4	-	14	-	-	2	3
1/24	09°34'S	139°50'W	2	-	2	-	2	-	-	1	1	-	-	3	2	50	-	-	-	-	-	1	1
1/25	08°58'S	140°39'W	6	-	1	5	6	5	-	1	3	-	-	3	2	40	4	-	1	-	-	5	1
1/27	08°49'S	140°04'W	19	2	9	8	17	9	3	7	7	-	-	25	25	83	10	1	15	-	1	5	11
1/28	09°18'S	137°50'W	6	-	2	4	6	5	-	3	4	-	-	9	1	17	4	1	8	-	-	3	3
1/29	09°10'S	136°44'W	8	1	4	3	8	5	-	5	3	-	-	2	9	18	4	1	2	-	-	3	6
1/30	09°12'S	139°21'W	7	-	1	6	7	4	-	1	4	-	-	53	10	120	13	1	23	-	1	3	4
1/31	11°15'S	139°43'W	3	1	2	-	3	2	-	-	1	-	-	16	11	57	3	4	7	-	-	1	2
2/1	12°17'S	139°40'W	7	1	4	2	7	4	-	1	6	-	-	7	3	19	3	1	-	-	-	5	2
2/2	09°36'S	139°40'W	11	1	4	6	11	5	-	1	6	-	-	41	11	136	4	2	5	-	-	3	7
2/5	09°12'S	140°30'W	10	1	8	1	10	5	-	1	9	-	-	24	20	98	5	1	9	-	1	3	4
2/6	09°03'S	142°30'W	4	1	2	1	4	1	-	1	2	-	-	11	3	38	3	1	7	-	-	1	2
2/7	09°14'S	141°24'W	4	-	3	1	3	2	-	1	4	-	-	16	2	43	-	1	7	-	-	2	1
2/8	08°56'S	139°34'W	1	-	-	1	-	1	-	1	1	-	-	2	-	73	-	1	-	-	-	-	1
2/9	08°17'S	139°40'W	10	-	4	6	10	5	-	1	5	-	-	34	27	140	11	-	18	-	-	6	4
2/10	05°56'S	139°28'W	11	2	8	1	11	9	-	3	9	-	-	5	3	34	2	1	6	-	-	4	7
2/11	07°28'S	139°34'W	9	-	4	5	9	6	-	3	6	-	-	17	14	130	3	2	13	-	-	3	5
2/15	08°56'S	140°05'W	2	-	2	-	2	2	-	-	2	-	-	2	9	32	3	-	1	-	-	-	2
2/16	06°23'S	141°09'W	2	-	-	2	2	2	1	2	1	-	-	6	29	46	3	-	14	-	-	1	1
2/17	03°21'S	143°33'W	5	-	3	2	5	2	-	1	4	-	-	5	5	13	4	-	16	-	-	1	4
2/18	00°12'N	145°24'W	6	-	6	-	6	1	-	2	4	-	-	4	7	16	2	1	18	-	-	-	4
2/19	03°34'N	146°55'W	2	-	2	-	2	1	-	1	-	-	-	6	4	33	5	2	7	-	-	-	2
2/20	06°49'N	148°12'W	1	-	1	-	1	1	-	-	1	-	-	12	4	2	1	4	11	-	-	-	-
2/21	10°00'N	149°00'W	11	1	6	4	11	5	1	1	11	-	-	29	7	18	10	17	8	-	-	-	10
2/22	13°26'N	151°45'W	1	-	1	-	1	-	-	-	-	-	-	15	3	9	-	-	5	-	-	-	1
2/23	16°30'N	154°00'W	-	-	-	-	-	-	-	-	-	-	-	6	5	6	1	-	1	-	-	-	-
2/24	19°10'N	156°16'W	2	-	1	1	2	1	-	-	2	-	24	15	11	6	-	-	1	-	-	1	1
2/27	IGY Station		-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-	-	-	-
	Total		254	13	131	110	244	135	6	67	147	-	69	652	535	2,554	213	69	320	1	9	79	136

Table 45. --Record of daily sightings of bird flocks, scattered birds, and tuna schools, Charles H. Gilbert cruise 38

Date, 1958	Noon position		Flocks										Scattered birds								Tuna schools		
	Latitude	Longitude	Total number	Size			Composition																
				<10	10 - 50	>50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified
2/8	21°39'N	158°24'W	3	1	1	1	1	2	-	1	2	-	6	17	10	-	-	-	-	2	-	2	1
2/9	20°12'N	157°18'W	4	1	1	2	1	1	-	-	1	-	-	6	1	5	-	-	-	-	-	1	2
2/10	17°23'N	155°46'W	2	1	1	-	1	-	1	-	1	-	-	1	1	5	-	-	-	-	-	-	-
2/11	14°49'N	154°32'W	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	1	-	-	-	-
2/12	12°06'N	153°14'W	1	1	-	-	1	-	-	-	-	-	-	1	-	1	-	1	1	-	-	-	-
2/13	09°16'N	152°00'W	4	1	3	-	4	-	-	-	-	-	-	13	-	5	-	4	5	-	-	1	-
2/14	06°32'N	150°05'W	-	-	-	-	-	-	-	-	-	-	-	3	2	3	-	-	9	-	-	-	-
2/16	03°52'N	150°00'W	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	1	-	-	-	4	-
2/17	02°57'N	150°17'W	1	-	1	-	-	1	-	-	-	-	-	1	5	-	1	-	2	-	-	1	-
2/18	01°53'N	150°20'W	-	-	-	-	-	-	-	-	-	-	-	-	5	1	-	1	1	-	-	-	-
2/19	00°53'N	150°19'W	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-	4	-	-	-	-
2/20	00°11'N	150°02'W	-	-	-	-	-	-	-	-	-	-	-	5	7	11	-	1	10	-	-	-	-
2/21	00°45'S	150°12'W	-	-	-	-	-	-	-	-	-	-	-	2	5	1	-	-	3	-	-	-	-
2/22	02°31'S	148°33'W	2	-	2	-	2	2	-	-	-	-	-	2	-	3	1	-	11	-	-	1	-
2/23	04°14'S	145°55'W	2	-	2	-	2	2	-	-	-	-	-	2	1	3	-	-	4	-	-	-	-
2/24	06°28'S	143°08'W	1	-	1	-	1	1	-	-	-	-	-	-	1	7	-	-	5	-	-	-	-
2/25	08°40'S	140°29'W	14	-	3	11	14	10	-	5	11	-	-	9	17	54	11	-	-	-	-	1	10
2/27	08°34'S	140°36'W	21	-	3	18	20	13	1	10	5	-	-	-	15	29	1	1	2	-	2[1]	7[2]	12
2/28	07°42'S	140°10'W	17	1	5	11	15	11	-	3	-	-	-	4	37	131	35	2	2	-	3[2]	2[1]	8
3/1	08°42'S	139°18'W	12	-	2	10	12	10	-	9	6	-	-	1	3	117	10	-	1	-	3[3]	4[3]	5
3/2	09°28'S	138°53'W	12	-	1	11	12	9	-	4	4	-	-	7	4	86	8	1	2	-	2[3]	5[3]	5
3/3	10°06'S	138°52'W	7	-	1	6	7	3	-	2	-	-	-	-	1	44	-	-	-	-	-	2	4
3/4	10°02'S	139°06'W	9	-	2	7	9	5	-	4	1	-	-	4	8	33	11	-	-	-	-	2	5
3/5	09°36'S	139°48'W	11	-	2	9	9	-	-	2	4	-	-	1	5	101	9	12	-	-	-	2	7
3/6	09°34'S	139°49'W	5	-	1	4	5	3	-	1	4	-	-	14	4	54	-	1	2	-	-	2	2
3/7	Taiohae,	Nuku Hiva	14	-	3	11	14	4	-	1	7	-	-	28	5	105	2	-	-	-	-	6	7
3/10	10°31'S	142°06'W	5	-	2	3	5	1	-	2	4	-	-	2	1	21	4	5	1	-	-	-	2
3/11	12°42'S	144°18'W	3	-	1	2	3	-	1	1	1	-	-	2	-	27	-	-	4	-	-	-	2
3/12	14°46'S	146°53'W	9	-	-	9	8	8	2	5	6	-	-	3	-	90	1	-	-	-	-	3	6
3/13	14°57'S	147°56'W	5	-	-	5	3	3	-	1	3	-	-	-	6	76	1	-	-	-	-	1	4
3/14	15°23'S	148°08'W	5	1	2	2	4	4	-	1	2	-	-	13	14	30	2	2	2	-	-	-	2
3/19	17°22'S	149°25'W	1	-	-	1	1	1	-	-	-	-	-	-	8	6	-	-	1	-	-	-	1
3/20	15°24'S	147°14'W	10	-	3	7	10	3	-	4	-	-	-	2	3	27	7	1	-	-	-	-	7
3/21	13°20'S	144°60'W	8	-	5	3	8	2	-	2	1	-	-	1	-	24	-	-	-	-	-	-	3
3/22	11°09'S	142°52'W	3	-	1	2	3	1	-	1	1	-	-	8	2	9	1	-	1	-	-	-	2
3/23	09°24'S	140°43'W	21	-	2	19	21	21	-	13	11	-	-	11	3	57	9	-	-	-	-	2	17
3/26	09°10'S	138°58'W	6	-	3	3	6	3	-	3	4	-	-	7	8	72	3	2	5	-	-	2	1
3/27	09°12'S	136°36'W	1	-	-	1	1	1	-	1	-	-	-	9	4	17	2	-	-	-	-	-	1
3/28	09°01'S	137°54'W	4	-	1	3	4	2	-	4	2	-	-	3	2	34	2	-	7	-	-	1	2
3/29	08°20'S	139°40'W	12	-	2	10	11	9	-	7	6	-	-	8	16	60	4	-	5	-	1	5	4
3/30	05°52'S	139°38'W	4	-	1	3	4	3	-	2	1	-	-	13	7	20	-	-	4	-	-	1	2
3/31	07°25'S	139°40'W	5	-	4	1	5	2	-	-	2	-	-	406	23	44	-	1	6	-	-	1	-
4/3	09°10'S	140°32'W	11	-	5	6	11	3	-	3	4	-	-	32	8	92	3	-	-	-	-	4	4
4/4	09°08'S	143°02'W	2	-	2	-	2	-	-	2	1	-	-	1	4	21	-	-	2	-	-	1	-
4/5	09°09'S	141°22'W	11	-	9	2	10	6	-	2	3	-	-	13	4	56	-	-	1	-	-	2	2

[1] Mixed schools

[2] Includes 2 mixed schools

[3] Includes 1 mixed school

Table 45.--Record of daily sightings of bird flocks, scattered birds, and tuna schools, Charles H. Gilbert cruise 38 (cont'd)

Date, 1958	Noon position		Flocks										Scattered birds								Tuna schools		
			Total number	Size			Composition																
	Latitude	Longitude		<10	10 - 50	>50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified
4/6	10°04'S	139°41'W	9	-	5	4	9	5	-	1	4	-	-	37	8	131	2	-	5	-	1[4]	2[3]	2
4/7	12°31'S	139°47'W	6	-	5	1	6	3	-	2	3	-	-	21	-	34	-	3	1	-	-	-	1
4/8	10°56'S	139°43'W	4	-	4	-	4	-	-	1	-	-	-	36	3	73	-	1	4	-	-	-	-
4/9	Taipi Vaii, Nuku Hiva		3	-	2	1	3	-	-	-	-	-	-	2	7	64	-	-	-	-	-	1	-
4/11	08°32'S	140°40'W	11	-	1	10	11	8	-	3	2	-	-	54	67	532	4	-	-	-	1[4]	4[3]	6
4/12	07°50'S	140°06'W	6	-	2	4	6	2	-	3	-	-	-	13	55	139	5	2	1	-	-	1	3
4/13	08°44'S	139°32'W	7	-	3	4	7	5	-	1	2	-	-	8	6	69	2	-	2	-	-	2	2
4/14	09°34'S	138°54'W	12	-	2	10	12	7	-	1	4	-	-	3	26	114	2	-	3	-	2[1]	6[2]	4
4/15	10°12'S	138°50'W	7	-	2	5	7	5	-	3	1	-	-	3	2	85	9	-	-	-	1[4]	2[3]	3
4/16	09°57'S	139°07'W	2	-	-	2	2	2	-	-	1	0	0	39	14	113	1	-	1	-	-	1	1
4/17	09°33'S	139°50'W	6	-	1	5	6	3	-	3	4	-	-	15	7	118	2	1	3	-	-	1	4
4/18	09°32'S	139°54'W	10	-	2	8	10	3	-	6	5	-	-	9	3	10	-	-	-	-	-	4	5
4/19	Taiohae,	Nuku Hiva	6	-	2	4	6	3	-	1	-	-	-	-	8	46	-	-	2	-	-	2	3
4/21	08°58'S	140°11'W	16	-	-	16	15	13	-	7	14	-	-	2	12	45	5	-	-	-	-	3	13
4/22	06°19'S	141°50'W	12	-	2	10	12	3	-	3	4	-	-	5	7	24	-	1	1	-	-	2	8
4/23	03°30'S	143°32'W	-	-	-	-	-	-	-	-	-	-	-	10	3	67	-	-	2	-	-	-	-
4/24	00°41'S	145°25'W	5	-	4	1	4	1	-	-	-	-	-	10	4	16	-	-	1	-	-	2	1
4/25	02°14'N	147°08'W	-	-	-	-	-	-	-	-	-	-	-	13	1	4	4	1	-	-	-	-	-
4/26	05°05'N	148°41'W	-	-	-	-	-	-	-	-	-	-	-	53	1	14	-	2	-	-	-	-	-
4/27	07°50'N	150°12'W	1	-	-	1	1	1	-	-	1	-	-	12	-	-	-	1	4	1	-	-	1
4/28	10°42'N	151°58'W	-	-	-	-	-	-	-	-	-	-	-	14	-	3	-	-	3	-	-	-	-
4/29	13°38'N	153°38'W	-	-	-	-	-	-	-	-	-	-	-	10	-	2	-	-	4	-	-	-	-
4/30	16°42'N	155°08'W	-	-	-	-	-	-	-	-	-	-	-	13	-	3	-	-	1	-	-	-	-
5/1	19°33'N	156°36'W	7	-	3	4	6	1	-	2	6	-	3	41	15	5	15	-	10	-	-	3	1
		Total	398	7	118	273	377	215	5	133	149	-	9	1,080	506	3,295	181	48	152	3	16[5]	102[5]	188

[1] Mixed schools

[2] Includes 2 mixed schools

[3] Includes 1 mixed school

[4] Mixed school

[5] Includes 11 mixed schools

Table 46.--Record of daily sightings of bird flocks, scattered birds, and tuna schools, Hugh M. Smith cruise 45

Date, 1958	Noon position		Flocks										Scattered birds								Tuna schools		
				Size			Composition																
	Latitude	Longitude	Total number	< 10	10 - 50	> 50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified
3/28	Honolulu, Hawaii		-	-	-	-	-	-	-	-	-	-	8	7	-	12	-	-	-	-	-	-	-
3/29	19°17'N	156°13'W	4	2	2	-	4	1	-	1	3	-	6	24	2	22	-	-	-	-	-	-	2
3/30	16°58'N	153°54'W	-	-	-	-	-	-	-	-	-	-	3	26	-	6	-	-	7	-	-	-	-
3/31	14°56'N	151°46'W	-	-	-	-	-	-	-	-	-	-	-	16	-	2	-	-	4	-	-	-	-
4/1	12°56'N	149°32'W	1	-	1	-	1	-	-	1	1	-	-	31	-	5	-	-	3	-	-	-	1
4/2	10°50'N	147°18'W	-	-	-	-	-	-	-	-	-	-	-	21	-	-	-	1	12	-	-	-	-
4/3	08°48'N	144°56'W	-	-	-	-	-	-	-	-	-	-	-	51	-	1	-	1	22	-	-	-	-
4/4	06°50'N	142°43'W	-	-	-	-	-	-	-	-	-	-	-	93	2	2	-	2	12	-	-	-	-
4/5	05°03'N	140°02'W	3	-	3	-	3	2	-	-	3	-	-	66	-	6	-	1	55	1	-	1	-
4/6	03°02'N	140°01'W	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	10	-	-	-	-
4/7	01°02'N	139°59'W	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	6	-	-	-	-
4/8	00°24'S	140°05'W	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	3	-	-	-	-
4/9	02°38'S	140°02'W	-	-	-	-	-	-	-	-	-	-	-	3	-	2	-	2	1	-	-	-	-
4/10	03°48'S	140°12'W	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-	1	1	-	-	-	-
4/11	00°04'S	139°59'W	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-	1	43	-	-	-	-
4/12	00°01'S	140°00'W	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	1	-	-	-	-
4/13	00°02'S	140°00'W	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-
4/14	00°01'S	140°00'W	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-
4/15	00°01'S	139°58'W	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-
4/18	01°18'N	140°02'W	1	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1	1	-
4/19	03°04'N	139°59'W	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-	-	7	1	-	-	-
4/20	01°36'N	140°03'W	-	-	-	-	-	-	-	-	-	-	-	8	1	-	-	-	3	-	-	-	-
4/21	00°08'S	139°59'W	1	-	1	-	1	-	-	1	1	-	-	19	-	4	-	-	12	-	-	1	-
4/22	02°12'S	140°10'W	2	-	1	1	2	-	-	2	2	-	-	15	-	4	1	1	2	-	-	1	-
4/23	02°06'S	140°10'W	5	-	1	4	4	2	2	-	5	-	-	32	-	8	-	2	6	-	-	2	3
4/24	00°02'S	139°58'W	-	-	-	-	-	-	-	-	-	-	-	6	-	1	-	-	8	-	-	-	-
4/25	00°12'N	140°09'W	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	1	-	-	-	-
4/27	00°05'N	140°06'W	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	10	-	-	-	-
4/28	03°00'S	142°06'W	4	1	3	-	4	-	-	-	1	-	-	11	2	17	1	-	2	-	-	-	-
4/29	06°32'S	144°09'W	1	-	-	1	1	-	-	1	-	-	-	21	-	2	-	1	7	-	-	-	1
4/30	10°03'S	145°49'W	3	-	3	-	3	-	2	1	1	-	-	11	-	6	4	2	5	-	-	1	-
5/1	13°22'S	147°47'W	4	-	4	-	4	-	-	1	1	-	-	4	-	9	-	1	3	-	-	-	1
5/2	17°10'S	149°24'W	4	-	1	3	4	4	-	-	1	-	-	7	47	79	1	-	-	-	-	2	-
5/6	17°27'S	149°28'W	3	-	-	3	3	3	-	1	1	-	-	7	23	53	-	1	-	-	-	-	3
5/7	17°10'S	148°33'W	8	-	3	5	6	8	2	2	6	-	-	26	23	43	3	-	1	-	-	1	4
5/8	15°14'S	146°57'W	9	-	1	8	8	9	1	2	5	-	-	2	6	31	3	2	-	-	-	3	6
5/9	12°42'S	144°24'W	5	-	3	2	5	2	-	2	2	-	-	10	-	11	-	-	-	-	-	2	1
5/10	10°28'S	141°53'W	8	-	5	3	8	6	-	4	3	-	-	17	3	15	1	1	1	-	-	-	3
5/11	08°56'S	140°05'W	4	-	2	2	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
5/15	09°14'S	138°58'W	5	-	3	2	5	5	-	2	4	-	-	32	51	181	10	1	9	-	-	1	2
5/16	09°10'S	136°27'W	3	-	1	2	3	3	-	2	2	-	-	19	8	44	2	1	1	-	-	2	-
5/17	09°16'S	138°03'W	8	-	8	-	8	5	1	5	4	-	-	21	22	65	7	3	4	-	-	2	-
5/19	09°16'S	140°28'W	9	1	4	4	9	7	-	7	1	-	-	118	21	250	13	5	14	-	-	1	4
5/20	09°17'S	142°54'W	5	2	2	1	5	2	-	1	1	-	-	21	8	25	1	2	9	-	-	1	-
5/21	09°14'S	141°21'W	7	2	2	3	7	3	-	3	5	-	-	16	5	60	12	2	1	-	1[1]	3[2]	-

[1] Mixed with skipjack.

[2] One school mixed with yellowfin.

Table 46.--Record of daily sightings of bird flocks, scattered birds, and tuna schools, Hugh M. Smith cruise 45 (cont'd)

Date, 1958	Noon position		Flocks										Scattered birds								Tuna schools		
				Size			Composition																
	Latitude	Longitude	Total number	< 10	10 - 50	> 50	Terns	Boobies	Bo'sun birds	Frigate birds	Petrels or shearwaters	Other	Albatross	Petrels or shearwaters	Boobies	Terns	Frigate birds	Bo'sun birds	Storm petrels	Other	Yellowfin	Skipjack	Unidentified
5/22	08°58'S	140°09'W	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
5/23	08°24'S	139°40'W	7	1	5	1	7	3	-	3	-	-	-	25	23	815	11	-	9	-	-	-	1
5/24	05°59'S	139°36'W	14	3	10	1	13	5	1	4	3	-	-	4	3	113	3	2	13	-	-	7	3
5/25	07°24'S	139°42'W	10	3	6	1	10	6	-	2	3	-	-	23	10	77	4	-	4	-	-	2	-
5/27	10°00'S	139°40'W	12	1	6	5	12	7	-	2	3	-	-	96	23	132	10	-	13	-	-	2	1
5/28	12°20'S	139°43'W	12	2	7	3	12	-	1	1	3	-	-	13	-	47	2	2	-	-	-	7	1
5/29	10°55'S	139°45'W	15	3	11	1	16	3	1	4	8	-	-	34	2	81	12	1	2	-	-	10	1
6/1	08°29'S	140°38'W	8	2	2	4	8	6	-	2	2	-	-	5	48	453	28	1	3	-	-	4	1
6/2	07°45'S	140°12'W	16	-	8	8	16	14	1	6	7	-	-	25	61	385	34	2	2	-	-	3	6
6/3	08°40'S	139°20'W	13	1	8	4	13	5	-	4	-	-	-	16	8	417	3	3	2	-	-	2	2
6/5	09°27'S	138°54'W	20	1	5	14	20	12	-	4	5	-	-	38	52	393	20	4	11	-	-	6	8
6/6	09°45'S	139°10'W	8	-	6	2	8	3	-	-	-	-	-	10	20	196	3	4	-	-	-	1	2
6/7	10°19'S	138°30'W	16	1	8	7	15	10	2	6	4	-	-	23	68	570	46	8	20	-	-	2	5
6/8	09°48'S	139°29'W	15	-	10	5	15	9	-	2	6	-	-	33	20	268	12	4	10	-	-	3	4
6/9	09°34'S	139°49'W	13	-	3	10	8	6	-	2	5	-	-	3	13	116	11	1	4	-	-	8	5
6/10	08°56'S	140°05'W	4	-	1	3	4	2	-	2	-	-	-	42	13	143	5	2	5	-	-	1	2
6/13	06°33'S	139°08'W	6	-	5	1	6	3	1	5	1	-	-	14	4	94	-	1	4	-	-	2	-
6/14	02°56'S	139°34'W	6	1	5	-	6	1	-	3	2	-	-	21	2	37	2	2	3	-	-	1	2
6/15	00°08'N	140°10'W	2	-	1	1	2	-	-	-	-	-	-	5	-	2	-	-	6	-	-	-	1
6/16	03°00'N	142°23'W	1	-	1	-	1	-	-	1	1	-	-	12	-	3	1	1	8	-	-	-	-
6/17	05°54'N	144°05'W	-	-	-	-	-	-	-	-	-	-	-	21	-	-	-	-	8	-	-	-	-
6/18	08°22'N	146°00'W	2	-	1	1	2	1	1	1	2	-	-	92	1	-	1	5	6	-	-	-	1
6/19	11°08'N	148°20'W	4	-	4	-	3	-	-	-	4	-	-	57	1	3	-	5	2	-	-	-	-
6/20	13°45'N	150°28'W	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-
6/21	16°32'N	152°35'W	-	-	-	-	-	-	-	-	-	-	-	11	-	1	-	1	-	-	-	-	-
6/22	18°45'N	155°38'W	7	1	3	3	7	-	1	-	7	-	-	50	-	7	2	1	1	-	-	2	4
6/23	21°17'N	157°53'W	3	-	2	1	3	2	1	2	2	-	-	9	9	47	2	-	-	-	-	-	1
		Total	322	28	174	120	310	164	18	96	122	-	17	1,586	606	5,366	271	84	426	2	2[3/]	89[3/]	84

[3/] Includes 1 mixed school.

Table 47.--Record of aquatic mammals sighted, *Charles H. Gilbert* cruises 35 and 38, *Hugh M. Smith* cruises 43 and 45

Vessel	Date	Time, LT	Position		Observation	Number
			Latitude	Longitude		
CHG-35	10/7/57	1620	06°41'N	148°24'W	Porpoise	12-24
"	10/12/57	1440	07°18'S	140°49'W	"	100
"	10/14/57	0600	08°58'S	140°11'W	"	12
"	10/14/57	0944	08°39'S	140°35'W	"	10
"	10/17/57	1338	09°46'S	138°46'W	"	12
"	10/18/57	0530	09°56'S	138°55'W	"	6
"	10/20/57	1040	09°31'S	139°54'W	"	20
"	10/29/57	1250	11°09'S	140°26'W	"	50
"	11/4/57	1305	08°13'S	140°31'W	"	3
"	11/4/57	1430	08°14'S	140°38'W	"	4
"	11/13/57	1734	16°13'S	148°31'W	Whale	1
"	11/24/57	0600	08°54'S	140°16'W	Porpoise	12-24
"	11/28/57	1605	10°24'S	138°43'W	"	2,000
"	11/29/57	1230	09°52'S	139°01'W	"	6
"	12/4/57	0615	07°57'S	140°42'W	"	200
"	12/13/57	1250	19°45'N	156°06'W	"	-
HMS-43	1/19/58	1350	07°52'S	140°02'W	"	250
"	1/21/58	1555	09°48'S	138°51'W	"	2
"	1/24/58	1632	09°26'S	140°06'W	"	50
"	1/24/58	1651	09°23'S	140°08'W	"	15
"	1/27/58	1330	08°47'S	140°00'W	"	15
"	1/30/58	1220	09°12'S	139°23'W	"	6
"	2/2/58	1400	09°19'S	139°40'W	"	4
CHG-38	2/9/58	1303	20°05'N	157°15'W	Whale	2
HMS-43	2/11/58	1220	07°30'S	139°34'W	"	1
"	2/11/58	1740	08°13'S	139°32'W	Porpoise	50
CHG-38	2/22/58	1332	02°35'S	148°26'W	"	2
HMS-43	2/22/58	1428	13°45'N	151°59'W	Whale	2
CHG-38	2/25/58	1120	08°37'S	140°31'W	Porpoise	15-25
"	2/27/58	0856	08°50'S	140°16'W	Pilot whale	60
"	2/27/58	0948	08°46'S	140°22'W	Porpoise	3
"	2/27/58	1110	08°49'S	140°35'W	"	100
"	2/27/58	1233	08°30'S	140°36'W	"	6
"	2/27/58	1250	08°28'S	140°37'W	"	30
"	2/27/58	1630	08°00'S	140°43'W	"	10
"	3/1/58	1429	08°51'S	139°28'W	"	6
"	3/2/58	1143	09°27'S	138°55'W	"	5
"	3/3/58	1115	10°03'S	138°52'W	"	5
"	3/4/58	1210	10°02'S	139°07'W	"	6
"	3/13/58	1500	14°54'S	147°45'W	"	4
"	3/23/58	1735	09°03'S	140°14'W	"	15
HMS-45	4/3/58	1120	08°47'N	144°54'W	Blackfish	4
"	4/3/58	1301	09°10'S	140°34'W	Porpoise	3
"	4/4/58	1509	09°09'S	143°17'W	"	1
"	4/5/58	1215	05°00'S	140°02'W	Whale	1
"	4/6/58	0520	09°19'S	140°41'W	Porpoise	6
"	4/6/58	0605	09°30'S	140°41'W	"	13
"	4/7/58	1325	12°40'S	140°40'W	Whale	4
"	4/7/58	1450	12°56'S	140°45'W	"	-
"	4/7/58	1700	12°50'S	139°46'W	Porpoise	-

Table 47.--Record of aquatic mammals sighted, Charles H. Gilbert cruises 35 and 38, Hugh M. Smith cruises 43 and 45 (cont'd)

Vessel	Date	Time, LT	Position		Observation	Number
			Latitude	Longitude		
HMS-45	4/7/58	1830	00°14'N	140°04'W	Sperm whale	1
"	4/9/58	0637	08°59'S	139°57'W	Porpoise	15
"	4/9/58	0726	08°56'S	139°59'W	"	20
"	4/11/58	0615	08°55'S	140°15'W	"	3
"	4/11/58	0630	08°54'S	140°16'W	"	2
"	4/11/58	0650	08°53'S	140°18'W	"	1
"	4/11/58	0700	08°52'S	140°19'W	"	2
"	4/11/58	0705	08°52'S	140°19'W	"	13
"	4/11/58	0922	00°33'S	140°01'W	"	1
"	4/11/58	1738	00°00'	140°00'W	"	50
"	4/13/58	1212	08°45'S	139°32'W	Pilot whale ?	-
"	4/13/58	1305	08°47'S	139°32'W	Porpoise	15
"	4/13/58	1735	00°00'	140°00'W	Blackfish	25
"	4/18/58	1318	-	-	"	15
"	4/25/58	1205	00°12'N	140°09'W	"	3
"	4/28/58	1740	03°48'S	142°35'W	Porpoise	500
"	5/25/58	1556	07°52'S	139°40'W	Humpback whale	4
"	5/27/58	1011	09°45'S	139°40'W	Porpoise	1
"	6/2/58	1500	07°51'S	139°55'W	"	50
"	6/5/58	1320	09°35'S	138°50'W	"	2
"	6/6/58	1145	09°47'S	139°12'W	"	30
"	6/7/58	1440	10°34'S	138°38'W	"	5
"	6/8/58	0656	10°18'S	138°55'W	"	-
"	6/8/58	1335	09°40'S	139°39'W	"	3
"	6/9/58	1547	09°28'S	140°05'W	"	1
"	6/10/58	1114	09°04'S	140°05'W	"	10
"	6/18/58	1755	08°59'N	146°31'W	Whale	1
"	6/23/58	0805	20°58'N	157°31'W	Porpoise	6

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BY DANIEL T. YAMASHITA

FISHERY BULLETIN 134
From Fishery Bulletin of the Fish and Wildlife Service

VOLUME 58

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR, Fred A. Seaton, *Secretary*
FISH AND WILDLIFE SERVICE, Arnie J. Suomela, *Commissioner*

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ABSTRACT

The catch statistics of the Hawaiian skipjack fishery and its associated live-bait fishery for the period 1900 through 1953 are brought together from all available records.

The various facets of the live-bait fishery, the only important one in the central Pacific, the methods of data collection for the skipjack and live-bait fisheries, and the completeness and accuracy of the catch records, are analyzed. Skipjack records in terms of weight caught were nearly complete for 1945 through 1953, as an estimated 94 percent of the catch was reported compared with an estimate of only two-thirds to three-fourths of the catch in earlier records. The bait-catch records for 1946 through 1953 were approximately 75 percent complete.

A description of the 1953 fishing fleet and the essential specifications of the sampans in the Territory of Hawaii, information which may be useful in evaluating future changes in catch per unit of effort, are presented.

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ANALYSIS OF CATCH STATISTICS OF THE HAWAIIAN SKIPJACK FISHERY

By **DANIEL T. YAMASHITA**, ***Fishery Research Biologist***

BUREAU OF COMMERCIAL FISHERIES

'he skipjack or aku, *Katsuwonus pelamis* nnaeus), is widely distributed over the world, urring in most tropical and subtropical seas. upports the largest fishery in Hawaii, both in ght and value of fish taken. The Pacific anic Fishery Investigations (POFI) of the ted States Fish and Wildlife Service has stud- the Hawaiian fishery and the general biology ne skipjack in this region as a part of its gen- program of research on the tuna resources of entral Pacific.

is report presents and analyzes the available 1 statistics for the Hawaiian skipjack fishery associated live-bait fishery for the period –1953. It includes historical data necessary n interpretation of the statistics, and also des a description of the 1953 fishing fleet, n may be helpful in evaluating future changes tch per unit of effort. It supplements a pre- report by June (1951), in which he described ethods used in the skipjack fishery.

e basic statistics used in this report, unless wise stated, have been collected by the iian Division of Fish and Game, and some been published in the form of biennial re- and monthly catch reports. The collection ch data is done routinely for fish of all s caught in Hawaiian waters.

n particularly indebted to Vernon E. Brock, or of the Hawaiian Division of Fish and for making the catch records available for nalysis, and to Yoshio Yamaguchi and su Shimizu for their generous help with udy.

THE SKIPJACK FISHERY

h a modest beginning, when the fish were r sold on the fresh market, the Hawaiian k fishery has developed into one of the important industries of Hawaii, with most of the fish now being canned. The present Honolulu cannery was established in 1917 and incorporated in 1922 as the Hawaiian Tuna Packers, Ltd. The Nawiliwili Canning Co., Ltd., began operation in 1951 at Nawiliwili, Kauai, but the cannery closed in 1954. At present, the Honolulu cannery and the fresh market are able to utilize all of the skipjack landed, which annually amounts to about 50 to 70 percent by weight of the total fish taken in the Territory.

The available statistics on these landings are presented in figure 1 and tables 1 and 2. These data show landings of less than a million pounds in 1900 and 1903, an annual average of about 5 million pounds from 1928 to 1936, and a pre-World War II peak of more than 13 million pounds in 1940. After the war the landings built up, with minor interruptions, from a low of less than a million pounds in 1944 to a peak of 12.9 million pounds in 1951, which was followed by a poor catch in 1952 and another good year in 1953.

TABLE 1.—*Weight and value of Hawaiian skipjack (*Katsuwonus pelamis*) landed before and during early period of World War II*

[Landings: in thousands of pounds; price: per pound]

Year	Market		Cannery		Total landings	Average price/pound
	Landings	Price	Landings	Price		
1900	422	$0.100			422	$0.100
1903	761	.041			761	.041
1928 [1]	2,878	.069	1,547	$0.020	4,425	.052
1929 [1]	2,964	.071	374	.026	3,338	.066
1930 [1]	3,918	.053	2,319	.023	6,237	.042
1931 [1]					6,123	
1932 [1]					3,162	.058
1933 [1]	2,892	.046	2,669	.020	5,561	.034
1934 [1]	2,982	.047	4,942	.023	7,924	.032
1935 [1]	4,873	.044			4,873	.044
1936 [1]	4,674	.038	[2] 989	[2] .037	5,663	.038
1936 [3]			2,071	.036	2,071	.036
1937	403	.053	12,384	.038	12,787	.039
1938	494	.054	9,228	.040	9,722	.041
1939	407	.058	8,198	.040	8,605	.041
1940	2,112	.036	11,308	.040	13,420	.039
1941	1,050	.040	2,602	.040	3,652	.040
1942					10	.278

[1] Fiscal year ending June 30.
[2] January to June 1936.
[3] July to December 1936.

Approved for publication April 4, 1957. Fishery Bulletin 134.

TABLE 2.—*Weight and value of Hawaiian skipjack* (Katsuwonus pelamis) *landed March 1944 to December 1953*

[Based on catch records of the Hawaiian Division of Fish and Game]

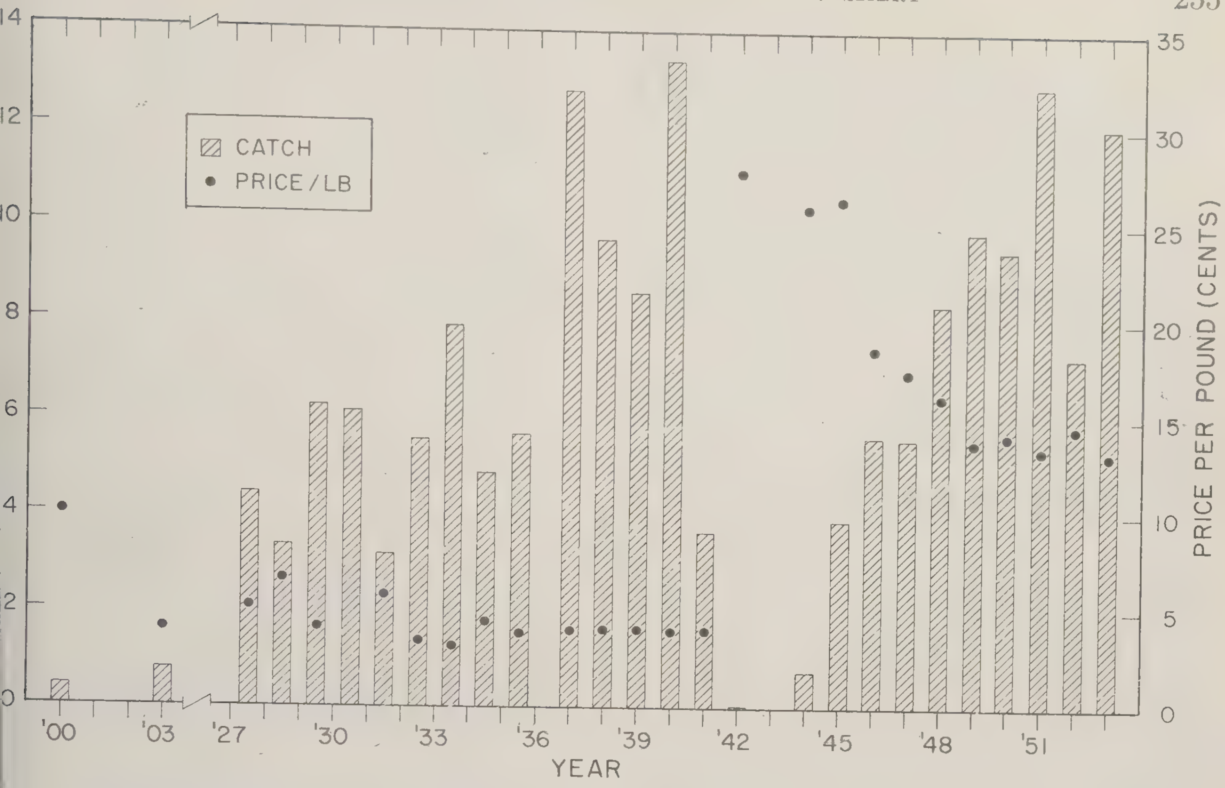
Year	January	February	March	April	May	June	July
1944:							
Pounds sold			41, 668	68, 914	132, 524	76, 751	35,
Price/pound			$0. 293	$0. 278	$0. 242	$0. 258	$0
1945:							
Pounds sold	71, 065	74, 278	84, 747	99, 384	160, 199	135, 327	532
Price/pound	$0. 272	$0. 250	$0. 251	$0. 251	$0. 262	$0. 270	$0
1946:							
Pounds sold	206, 952	249, 643	108, 119	245, 018	612, 493	981, 592	743,
Price/pound	$0. 240	$0. 275	$0. 276	$0. 274	$0. 262	$0. 157	$0.
1947:							
Pounds sold	441, 911	163, 975	232, 612	267, 894	316, 017	620, 835	1, 108,
Price/pound	$0. 205	$0. 263	$0. 272	$0. 256	$0. 226	$0. 146	$0
1948: [1]							
Pounds sold	672, 053	439, 680	236, 582	344, 552	568, 140	1, 136, 811	2, 034,
Price/pound	$0. 172	$0. 168	$0. 194	$0. 187	$0. 192	$0. 155	$0
Pounds caught	602, 142	395, 448	233, 327	335, 862	534, 758	999, 302	2, 038,
	(678, 841)	(444, 121)	(238, 972)	(348, 032)	(573, 879)	(1, 148, 294)	
1949:							
Pounds sold	68, 413	116, 327	120, 615	235, 465	1, 016, 826	2, 255, 535	1, 690,
Price/pound	$0. 319	$0. 261	$0. 309	$0. 304	$0. 138	$0. 119	$0
Pounds caught	68, 683	116, 625	121, 717	236, 392	1, 020, 457	2, 260, 284	1, 696
1950:							
Pounds sold	154, 562	141, 213	186, 494	399, 497	579, 600	982, 714	1, 942
Price/pound	$0. 211	$0. 204	$0. 228	$0. 190	$0. 152	$0. 140	$0
Pounds caught	157, 066	141, 932	187, 740	400, 973	581, 851	985, 410	1, 948,
1951: [2]							
Pounds sold	87, 123	86, 382	94, 178	525, 796	2, 287, 977	2, 577, 022	2, 312
Price/pound	$0. 238	$0. 238	$0. 379	$0. 182	$0. 132	$0. 128	$
Pounds caught	87, 489	87, 583	97, 094	529, 374	2, 295, 651	2, 584, 710	2, 323,
1952:							
Pounds sold	28, 771	89, 606	55, 721	384, 925	573, 965	814, 238	1, 649,
Price/pound	$0. 276	$0. 273	$0. 352	$0. 186	$0. 165	$0. 141	$0
Pounds caught	29, 054	89, 958	55, 867	387, 141	577, 992	818, 345	1, 654,
1953:							
Pounds sold	195, 193	203, 203	575, 884	862, 125	1, 236, 649	2, 237, 334	1, 56
Price/pound	$0. 248	$0. 204	$0. 148	$0. 134	$0. 128	$0. 125	$0
Pounds caught	200, 197	204, 139	576, 345	863, 700	1, 239, 585	2, 241, 430	1, 569
Weighted average price/pound	$0. 211	$0. 224	$0. 226	$0. 196	$0. 160	$0. 136	$0

Year	August	September	October	November	December	Total catch
1944:						
Pounds sold	59, 233	99, 016	123, 744	33, 921	62, 359	734, 012
Price/pound	$0. 254	$0. 254	$0. 259	$0. 231	$0. 278	
1945:						
Pounds sold	760, 035	663, 842	662, 358	436, 738	227, 258	3, 907, 302
Price/pound	$0. 282	$0. 275	$0. 253	$0. 255	$0. 264	
1946:						
Pounds sold	720, 829	589, 146	655, 367	400, 981	116, 844	5, 630, 251
Price/pound	$0. 136	$0. 147	$0. 141	$0. 237	$0. 326	
1947:						
Pounds sold	634, 219	507, 044	373, 019	465, 272	460, 096	5, 591, 536
Price/pound	$0. 146	$0. 145	$0. 160	$0. 178	$0. 179	
1948: [1]						
Pounds sold	1, 290, 683	878, 024	422, 843	234, 227	78, 552	8, 336, 951
Price/pound	$0. 144	$0. 152	$0. 175	$0. 225	$0. 253	
Pounds caught	1, 296, 645	879, 362	423, 636	234, 840	78, 974	8, 052, 641
						(8, 383, 941)
1949:						
Pounds sold	2, 421, 441	1, 035, 291	490, 509	255, 122	157, 605	9, 864, 009
Price/pound	$0. 121	$0. 129	$0. 153	$0. 186	$0. 178	
Pounds caught	2, 426, 601	1, 038, 151	491, 960	258, 735	158, 516	9, 894, 686
1950:						
Pounds sold	1, 801, 779	1, 174, 012	1, 020, 678	706, 048	391, 867	9, 481, 302
Price/pound	$0. 136	$0. 133	$0. 134	$0. 132	$0. 153	
Pounds caught	1, 805, 031	1, 176, 794	1, 022, 590	708, 271	395, 179	9, 511, 422
1951: [2]						
Pounds sold	2, 672, 960	1, 384, 488	410, 181	247, 062	188, 489	12, 874, 274
Price/pound	$0. 125	$0. 117	$0. 136	$0. 164	$0. 189	
Pounds caught	2, 683, 270	1, 387, 647	411, 595	248, 094	190, 313	12, 926, 309
1952:						
Pounds sold	1, 751, 162	983, 537	574, 324	109, 792	248, 022	7, 264, 019
Price/pound	$0. 129	$0. 134	$0. 136	$0. 202	$0. 214	
Pounds caught	1, 758, 153	986, 554	575, 603	110, 138	248, 649	7, 291, 851
1953:						
Pounds sold	2, 138, 806	1, 278, 507	1, 196, 400	217, 364	381, 830	12, 030, 537
Price/pound	$0. 123	$0. 129	$0. 132	$0. 161	$0. 144	
Pounds caught	2, 142, 181	1, 281, 278	1, 199, 164	218, 077	383, 537	12, 059, 406
Weighted average price/pound	$0. 138	$0. 145	$0. 157	$0. 190	$0. 194	

---

[1] Summarized late reports for pounds caught not available for January through June 1948. Adjusted catches, in parentheses, based on weight sold; future references to total catches for 1948 will be based on these figures.

[2] Published monthly catch statistics changed from pounds sold to pou caught in November 1951.



RE 1.—Annual Hawaiian skipjack catch (weight sold) and price per pound for all available years, 1900–1953. The data for 1928–36 are by fiscal years (July to June); data for 1937–53 are by calendar years.

e number of boats (sampans) engaged in the fishery has varied only slightly in recent years. e were 26 boats actively fishing for skipjack in as compared with 32 in 1948 (June 1951). apparent decrease during the 5-year period ave resulted from a change in the interpreta- of what constitutes a skipjack vessel. Many e smaller craft that fish for skipjack on a ime basis may not have been included in the records. Between 1948 and 1953 only 2 ampans joined the fleet, but 2 of the older (not included in the total count) were ed and lost during 1953.

size and design of the sampans are essen- as described by June (1951). The boats from 58.3 to 80.5 feet in registered length enerally are of wooden construction—only ve steel hulls. All are equipped with diesel s and are driven by a single screw. A major in recent years has been the replacement of of the older engines with new high-speed s rated up to 450 horsepower. As fishing is done close to port and the catch is landed a few hours of capture, the sampans do not have mechanical refrigeration systems but some carry ice. The basic specifications and distribution, by islands, of the 26 full-time skipjack boats operating in 1953 are given in appendix table 1, page 272.

The usual sequence of operations of a Hawaiian skipjack sampan is to catch bait on 1 or more days, depart for the fishing grounds early in the morning, fish, then return to port and unload the catch that night. If sufficient bait remains, the boat may depart the next day for the fishing grounds; if not, the operational sequence is repeated.

CATCH STATISTICS

Methods of Collection

The systematic collection of fishery statistics in Hawaii has evolved from occasional surveys through a stage of regular but relatively incomplete coverage to the present system, which endeavors to record the complete commercial production in the Territory.

The first statistics on the Hawaiian fishery, for 1900 and 1903, were believed to be complete by Cobb (1902, 1905), who collected them. In 1925, the legislature enacted a law requiring catch reports of fish dealers in the ports of Honolulu and Hilo. These reports, estimated to be two-thirds to three-fourths complete (Hawaii Commissioners of Agriculture and Forestry, 1946), were used in the compiling of the 1928 to 1942 catch records. It is probable that even after this legislation the reporting of catch data was still somewhat erratic, and that in the late 1920's and early 1930's the portion of the total catch reported may have been even smaller than this estimate.

In 1945 the 1925 law was amended to require catch reports from all fish dealers in the Territory; furthermore, a new law enacted in the same year required all owners or agents of licensed fishing craft to report their catches. Although this amendment was not passed until 1945, fish catch statistics from the major islands have been available since 1943. However, the catches for the period January 1943 through February 1944 were reported only in terms of the combined weight of all species landed.

The skipjack-catch report form has gone through a number of revisions since its introduction in March 1944. The initial form applied to all types of fishing on a monthly basis, whereas the present form provides for detailed information on individual fishing trips and is issued for skipjack reporting only (see appendix figs. 1–5, pp. 273-277). The catch statistics were compiled manually until 1947, when the punch-card method using IBM machines was introduced. This change has resulted in the preparation of more complete skipjack statistics since 1948.

In addition to the regular catch reports, interviews on 2 or 3 days a week with captains of the sampans were started in July 1949 (see appendix fig. 6, for a sample of the interview form). These interviews have been continued, during the summer months primarily, in order to obtain a better estimate of the catch per unit of effort of both skipjack and bait. The system was further modified in June 1953 by placing interview sheets on boats with the more cooperative captains who agreed to fill them in routinely. These sheets are collected and checked for additional information.

Completeness and Accuracy

It is apparent from the review of collection methods that the statistics for the Hawaiian skipjack fishery have been collected in a variety of ways and with varying degrees of completene and accuracy. An evaluation of the more rece catch statistics requires consideration both of th routine followed in the fishery (p. 255) and of th methods by which the statistics are reported.

The skipjack are sold to the cannery on a weigh basis, and it is the responsibility of the fisherme or their agents to report the exact weight sol and the price received, together with an estimate o the total weight and number of skipjack caught The total weight caught must be estimated, sinc the fish used for home consumption are usuall not weighed, nor are those fish weighed that spoile before they reached the cannery. As the amoun caught totals only about 1 percent more than th weight sold, errors in the estimate of total weigh are relatively unimportant. The number of fis caught is calculated from an estimate of the averag weight of the fish and the total weight of th catch. These reports are required of all person possessing commercial fishing licenses; howeve reports are required only for productive trips.

An important source of error in the catch sta tistics results from the occasional failure of fishe men to report their catches. An estimate of th unreported catches has been derived from a com parison of interview records and catch report for 1952. The unproductive trips, which ar often reported in the interview records but are no included in the catch reports, have been omitte from this analysis.

To evaluate the accuracy of the skipjack catc records, the extent of agreement between th interview records and the catch reports was de termined by comparing the dates and sizes o skipjack catches and the dates and sizes of th bait-fish catches in each. The localities of catc for skipjack and bait were occasionally used a criteria of agreement. Bait-catch localities wer usually in agreement in the two sets of report but oftentimes discrepancies arose in the report ing of the localities of skipjack catches (see p. 25 Based on the extent of agreement between the the interview and the catch records were classifie into five categories.

The first category is that in which an intervie record matches a catch report for a given catc An interview record was considered to match catch report when (1) the date of catch as dete mined by interview was not more than 2 day before the reported date of landing; (2) the ba h given in the interview was made on the e day, in the same locality, and in about the e quantity as in the catch report; and (3) estimated catch in the interview was within 75 ent of the reported catch.

he second category, in which more than 1 day's h as determined by interviews is included in a le catch report, occurred occasionally when jack were caught on successive days without iting. Reports falling in this category were gnized by (1) agreement in size and location of catch; (2) agreement (within 75 percent) veen the sum of two or more consecutive in- iew estimates of skipjack catches and the in the catch report; and (3) correspondence ite (within 2 days) between the last interview the catch report.

ie third category, in which catches listed in reports are much higher than those listed ie interview records, occurred in a few in- es. Such catches were regarded as suspi- ly high if the catches from individual trips her boats operating during the same period me were known to be small. In these in- es it is believed that the catches shown on the view records were combined into one catch t with other catches not covered by inter- . The part of the catch probably correspond- o that estimated in the interview was cal- d by applying the ratio of weighed to esti- l catch for the appropriate month (table . 8).

The fourth category includes interview records that were definitely not included in the catch reports. They were recognized when a check of all catch reports precluded the possibility of placing them in any one of the first three categories.

The fifth category includes the few instances in which the catch reported is not within 75 percent of the estimated catch from interviews and there is no evidence that would permit classifying the catch reports as category 3. Only 2.8 percent of the reports fell in this category, and these interview and catch records were eliminated from further consideration. Categories 3 and 5 were differentiated by determining whether the catch reports could have included catches not covered by the interview records. If there was any possibility, judging by the available records, of additional catches having been included in the catch report, the reports were placed in category 3.

From the comparison of catch reports and interview records the percentage of trips and the percentage of catch reported have been estimated for these different categories and are summarized in table 3. The trips for which there were interviews, exclusive of unproductive trips and those falling in category 5, have been listed in column 1. Column 2 lists the catches reported separately (category 1), and column 3 the catches reported in combined form (categories 2 and 3). Column 4 shows the percentage of trips reported

3.—*Comparison of interview records and catch reports for the Hawaiian skipjack* (Katsuwonus pelamis) *fishery, 1952*

Month	Trips					Catch (in pounds)						
	1	2	3	4	5	6	7	8	9	10	11	12
	Number of trips interviewed [1]	Catch reports, category 1	Catch reports, categories 2 and 3	Percent of trips separately reported	Percent of all trips reported	Estimated catch shown on interview record, category 1	Weighed catch shown on catch report, category 1	Ratio of weighed/estimated catch	Catch shown on interview records, categories 1, 2, 3, and 4	Computed catch all trips interviewed [2]	Catch shown on catch reports, categories, 1, 2, 3, and 4	Percent of catch reported [3]
	7	5	0	71. 4	71. 4	20, 800	21, 489	1. 033	25, 100	25, 928	21, 489	82. 9
	26	22	0	84. 6	84. 6	98, 200	104, 179	1. 061	101, 400	107, 585	104, 179	96. 8
	39	24	6	61. 5	76. 9	98, 500	103, 522	1. 051	155, 090	163, 000	145, 086	89. 0
	50	36	11	72. 0	94. 0	313, 600	321, 674	1. 026	409. 400	420, 044	403, 354	96. 0
er	40	32	6	80. 0	95. 0	201, 720	219, 585	1. 089	238, 870	260, 129	251, 080	96. 5
	40	28	7	70. 0	87. 5	76, 850	81, 526	1. 061	99, 450	105, 516	92, 654	87. 8
r	7	4	2	57. 1	85. 7	9, 000	10, 873	1. 208	11, 500	13, 892	12, 379	89. 1
	209	151	32			818, 670	862, 848		1, 040, 810	1, 097, 014	1, 030, 221	
ge				72. 2	87. 6			1. 054				93. 9

usive of unproductive trips and category 5.
mn 8×column 9.
mn 11÷column 10.

separately and column 5 the percentage of trips reported both separately and in combined form. On the average, 87.6 percent of the trips recorded by interview were reported in the catch reports; only 72.2 percent were reported as separate trips.

In order to estimate the total catch from the reported catch, it was necessary first to establish the relation between the fisherman's estimate of his catch and the true weight of the catch (table 3, cols. 6, 7, and 8). The results show that the weighed catch averages 1.054 times the estimated catch reported in the interview records since the tendency of the fishermen is to underestimate their catch. The total catch estimated by the fishermen in all interviews (col. 9) has been multiplied by the monthly ratios (col. 8) to obtain a computed total catch that should have been reported for all trips covered by interviews (col. 10). Column 11 includes the total catch from all catch reports that correspond to the interviews (col. 9). The percentage of catch reported (col. 12) averaged 93.9 percent of the probable total catch. This value is somewhat higher than that for percentage of trips reported (87.6 percent), and suggests that the fishermen tended to overlook the small catches in their catch reports. If it is assumed that the percentage by weight reported has been constant for the years 1945 to 1953, then the total annual catch may be estimated as shown in table 4.

A peak catch of 13.7 million pounds was estimated for 1951. If we assume that the prewar peak of 1940 was only three-fourths complete and actually totaled 17.9 million pounds instead of the reported 13.4 million, then the fishery has yet to attain the level of the prewar catches.

Table 4.—*Reported and estimated annual skipjack catch, 1937–53*

Year [1]	Reported catch (pounds) [2]	Estimated catch (millions of pounds)
1937	12, 787, 261	17. 0
1938	9, 722, 150	13. 0
1939	8, 604, 768	11. 5
1940	13, 420, 333	17. 9
1945	3, 907, 302	4. 6
1946	5, 630, 251	6. 0
1947	5, 591, 536	6. 0
1948	8, 336, 951	8. 9
1949	9, 864, 009	10. 5
1950	9, 481, 302	10. 1
1951	12, 874, 274	13. 7
1952	7, 264, 019	7. 7
1953	12, 030, 537	12. 8

[1] Reports assumed to be 75 percent complete for years 1937–40 (Hawaii Commissioners of Agriculture and Forestry, 1946) and 93.9 percent complete for 1945–53. No adequate data available for the war years, 1941–44.

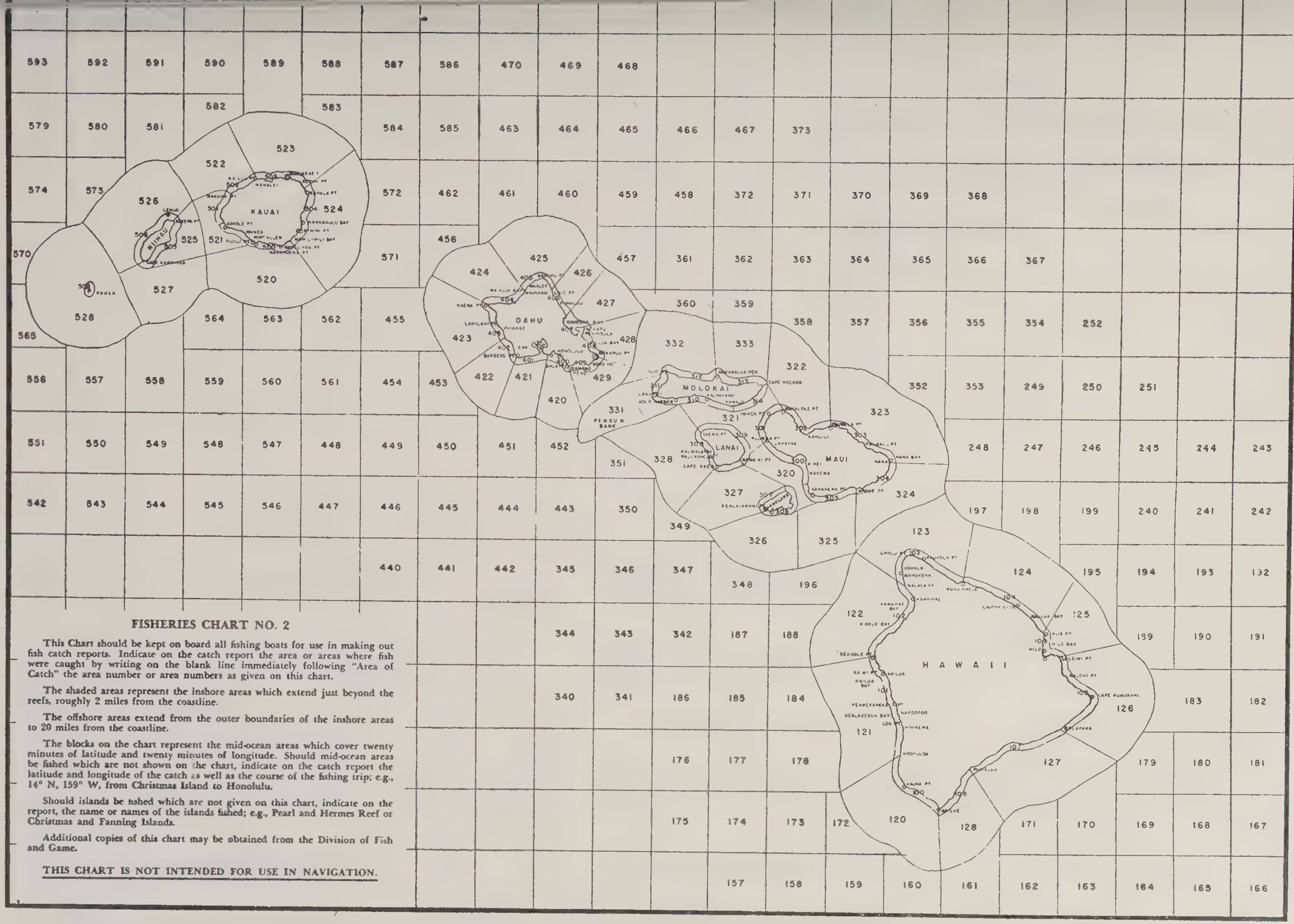
[2] Based on weight sold, from Hawaiian Division of Fish and Game records.

Another questionable aspect of the catch recor is related to the reporting of the localities which the catches were made. In the intervie the location was given by distance and directi from some reference point on land, and in t catch reports the location was identified by area number as shown in fisheries chart No. supplied by the Hawaiian Division of Fish a Game (fig. 2). Although the method of reporti differed between the interviews and the catch r ports, gross disagreements in catch localities we readily detected by comparing corresponding r ports from the two sources.

With reference to the designated fishing locali interview records and catch reports were separa into two groups: those showing agreement as catch locality and those not showing agreemen to catch locality. The reports were considered agreement if there was general correspondence to location and distance of the catch from a ref ence point on land. In spite of rather liber treatment, the number in agreement was on about 45 percent; in many cases the same cat was reported from opposite ends of an island even from different islands. Thus, assuming th the true catch locality was given when the t reports were in agreement, and that a fictitio locality was given when there was disagreeme between the reports, less than one-half of all ports show the true source of the catch. Hen any short-term study (within a year) on the loca ties of skipjack catch should be made in terms general rather than specific areas if results are be of value. However, errors in the comparis of specific areas over a period of years should less important.

Value and Weight of the Landings

The price received by fishermen for skipjack many years before World War II was about cents a pound, but it jumped to 28 cents wh landings were seriously curtailed by the wa The increase in landings after the war was ac companied by a decrease in price, which in 19 leveled off at about 14 cents a pound (table This is an average of the price paid by the canner about 12 cents, and the higher prices received the fresh fish market, particularly in seasons low landings. The gross annual receipts to fishermen were about a million dollars or more fr 1945 on and reached a peak of $1.7 million in 19



FISHERIES CHART NO. 2

This Chart should be kept on board all fishing boats for use in making out fish catch reports. Indicate on the catch report the area or areas where fish were caught by writing on the blank line immediately following "Area of Catch" the area number or area numbers as given on this chart.

The shaded areas represent the inshore areas which extend just beyond the reefs, roughly 2 miles from the coastline.

The offshore areas extend from the outer boundaries of the inshore areas to 20 miles from the coastline.

The blocks on the chart represent the mid-ocean areas which cover twenty minutes of latitude and twenty minutes of longitude. Should mid-ocean areas be fished which are not shown on the chart, indicate on the catch report the latitude and longitude of the catch as well as the course of the fishing trip; e.g., 14° N, 159° W, from Christmas Island to Honolulu.

Should islands be fished which are not given on this chart, indicate on the report, the name or names of the islands fished; e.g., Pearl and Hermes Reef or Christmas and Fanning Islands.

Additional copies of this chart may be obtained from the Division of Fish and Game.

THIS CHART IS NOT INTENDED FOR USE IN NAVIGATION.

FIGURE 2.—Hawaiian Division of Fish and Game fisheries chart No. 2, showing the statistical areas established for Hawaiian waters.

From 1928 through 1936 the catch totals were summarized only by fiscal years, but in subsequent years they are available for calendar and fiscal years. In some years the published reports do not designate whether the fish went to the market or to the cannery. In fiscal year 1936, the cannery reported its purchases for the period January through June 1936, but not for July through December 1935. The 1941 catch was low, partly because of the curtailment of fishing resulting from prewar naval maneuvers and wartime restrictions and partly because of the failure of some of the boats to operate during the first 6 months of the year owing to a controversy over the price of fish. None of these factors were serious enough to have distorted the general trend of increasing landings during the period ending in 1940.

Because of a change in the method of collecting data on the skipjack fishery, the postwar (World War II) catch statistics are much more complete than the records from 1928 through 1942. Some variations occur in the published figures, however, because from March 1944 to October 1951 the skipjack catch statistics were published in terms of weight sold, and in November 1951 this was changed to weight caught. Table 2 provides a comparison of the amount caught and the amount sold for the years 1948 to 1953 as compiled from both published and unpublished records of the Hawaiian Division of Fish and Game.

These statistics show an upward trend in the catch from 1944 to 1951, which appears to have been due partly to a changing fleet and partly to a change in relative abundance or availability of skipjack. There was a gradual increase in the number of vessels in operation from 1944 until the beginning of 1947, when about 26 vessels were engaged in full-time skipjack fishing. However, 10 of these sampans did not fish during the first 6 months of 1947 because of a disagreement over prices, and thus the first full year of fishing was 1948. The number of vessels in the fleet has remained nearly constant since the beginning of 1948.

Seasonal Variations in the Catch

The exploitation of skipjack in Hawaiian waters is highly seasonal and the bulk of the catch is landed during the months of May, June, July, August, and September (table 2). The average monthly landings reported for the years 1948 to 1953 are shown in figure 3. The reasons for thi large seasonal influx of skipjack into the fisher remain obscure, but food and spawning ma influence the movement into the fishery.

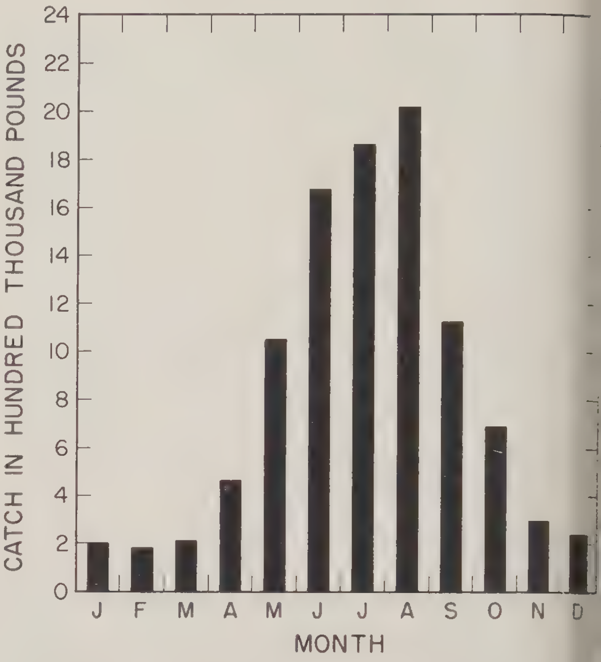


Figure 3.—Average monthly skipjack catch, 1948–53 based on records of the Hawaiian Division of Fish and Game.

King and Hida (1954) found that slightly mor plankton, and consequently more tuna food occurs in Hawaiian waters during the summe than in winter. It does not appear plausibl however, that a slight change in the food suppl could cause such a marked seasonal fluctuatio in the skipjack catch.

On the other hand, fishes are known to undertake long migrations in response to the spawnin urge. From an examination of skipjack ovarie in different months of the year, Brock (1954 found indications "that the spawning period probably extended from late February, March, or April to the first part of September," coincidental with the months of high skipjack landings. He also noticed that the fully ripe or spent fish were rarely found in the catches, indicating that they may be unavailable to the fishery when in this condition, and he found evidence that individual fish spawn repeatedly during one spawning season.

POFI investigations on larval tunas (Matsumoto 1958) support Brock's conclusion that skipk spawn during the summer. Matsumoto und that in plankton samples obtained in Aust, during a cruise in Hawaiian waters, 164 of e 326 identified tuna larvae were skipjack. e dominant size group was less than 6 mm. in gth, indicating that spawning could not have en far off either in time or space.

Experiences of skipjack fishermen with spawn- fish are also of interest. They have observed at "spawning schools," encountered infrequently ring the height of the season, are never fished ccessfully and, hence, are abandoned for more dily biting schools. The schools are considered be spawning because they are often seen in a ud of what is thought to be milt in the water.

f the seasonal abundance of skipjack in the waiian fishery is attributed to a spawning gration, the actual biological or oceanographic nditions causing this movement are not evident the present time.

e and Number of Fish in the Catch

The average weight and total number of skipk caught (table 5) were computed from the ch records for each month from 1948 through 3. A comparison of the data for those years wed that skipjack were taken in the greatest nbers and that the fish had the highest average ghts during the 2 best years, 1951 and 1953 4). The variation in number of fish landed ween the fair years of 1949 and 1950 and the r year of 1952 is relatively less than the ation in the total weight of fish landed, suging that skipjack may have been equally ndant during these years and that the differe in total catch was largely due to differences he size of the fish.

he success of fishing, and with it the magnitude he total catch in weight, is controlled, other gs being equal, by a combination of two fac- the absolute numbers of fish available and size of the fish. The good catches of 1951 1953 were due to the presence of large numof large fish, whereas the 1952 catch was poor use the skipjack were both few and small. sser abundance of fish may be compensated within limits by the presence of larger fish, , the third largest catch in weight, for the s under consideration, was recorded in 1949, this year ranked last in the total number of

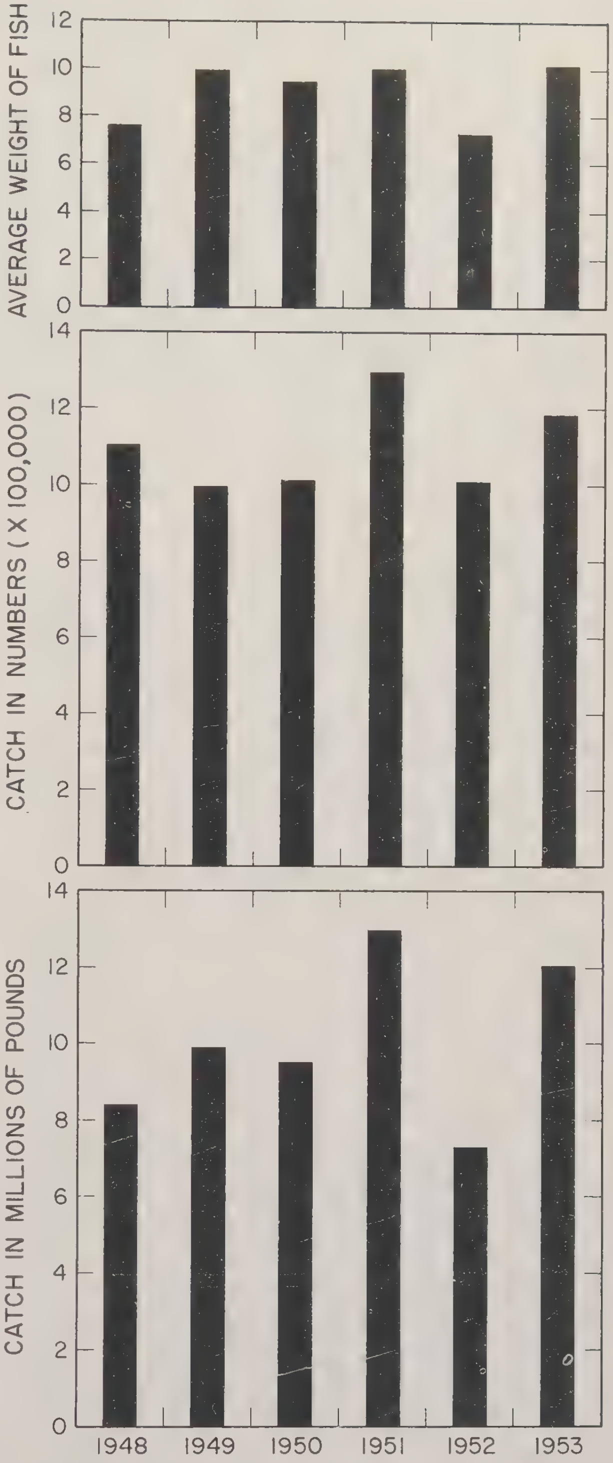


FIGURE 4.—Skipjack catch by average weight and number of fish taken and total catch, 1948–53, based on records of the Hawaiian Division of Fish and Game.

TABLE 5.—*Number and average weight of skipjack landings, by month and year, 1948–53*

[From Hawaiian Division of Fish and Game records; weight in pounds]

Month	1948		1949		1950		1951		1952		1953		Weighted average—	
	Number landed	Average weight	Number landed	Average weight	Number landed	Average weight	Number landed	Average weight	Number landed	Average weight	Number landed	Average weight	Number landed	Weig
January	[1] 66, 384	10. 226	10, 562	6. 503	27, 344	5. 744	11, 916	7. 342	4, 233	6. 863	14, 902	13. 434	24, 372	9. 0
February	[1] 43, 851	10. 128	14, 121	8. 259	21, 115	6. 722	8, 680	10. 090	11, 527	7. 804	26, 142	7. 809	21, 341	8. 6
March	[1] 56, 454	4. 233	15, 921	7. 645	39, 350	4. 771	15, 281	6. 354	7, 963	7. 016	55, 831	10. 323	31, 672	6. 6
April	[1] 78, 705	4. 422	36, 446	6. 486	53, 179	7. 540	61, 879	8. 555	58, 782	6. 586	105, 278	8. 204	66, 174	7. 0
May	[1] 84, 295	6. 808	93, 758	10. 884	80, 757	7. 205	160, 625	14. 292	82, 230	7. 029	128, 414	9. 653	112, 570	9. 9
June	[1] 224, 583	5. 113	160, 897	14. 048	105, 912	9. 304	198, 916	12. 994	101, 230	8. 084	157, 238	14. 255	157, 348	10. 5
July	199, 897	10. 197	136, 194	12. 457	117, 832	16. 537	360, 622	6. 443	224, 538	7. 368	190, 580	7. 922	183, 362	9. 08
August	130, 029	9. 972	225, 793	10. 747	159, 610	11. 309	232, 177	11. 557	269, 325	6. 528	190, 823	11. 226	197, 458	10. 02
September	128, 336	6. 852	137, 997	7. 523	191, 629	6. 141	129, 978	10. 676	113, 934	8. 659	137, 935	9. 289	137, 358	8. 03
October	49, 038	8. 639	92, 231	5. 334	100, 996	10. 125	61, 848	6. 655	93, 412	6. 162	106, 384	11. 272	85, 595	8. 18
November	30, 061	7. 812	46, 796	5. 529	59, 554	11. 893	32, 721	7. 582	14, 213	7. 749	22, 339	9. 762	35, 332	8. 64
December	10, 922	7. 231	23, 246	6. 819	51, 543	7. 667	22, 411	8. 492	25, 560	9. 728	50, 247	7. 633	30, 590	7. 91
Total number	1, 102, 555		993, 962		1, 008, 821		1, 297, 054		1, 006, 947		1, 186, 113		1, 083, 172	
Weighted average weight		7. 604		9. 955		9. 428		9. 966		7. 242		10. 167		9. 10

[1] Calculated from the adjusted total catch.

fish caught. Large catches in weight may also be obtained when large numbers of small fish are caught, however, the chances of a large catch in weight are far greater under the former condition, because the number of fish that can be caught with a given effort is somewhat independent of size for fish averaging less than 20 pounds. One report (Hawaii Commissioners of Agriculture and Forestry, 1952) states that the maximum efficiency can be realized in live-bait fishing by working skipjack schools that average between 15 to 20 pounds per fish. Fishing usually lasts 10 to 15 minutes for any one school or for a single pass at a school, hence a larger total weight can result from a "small number-larger size" combination than from a "large number-smaller size" combination.

Catch by Areas

The fishing of distant offshore grounds by the local fishery is restricted principally by the high bait mortality, the limited range of the sampans, and the lack of refrigeration for the catches. Of these three factors, live-bait mortality must be considered of primary importance. A 100-percent bait mortality even before reaching the fishing grounds is not an uncommon occurrence; consequently, much of the skipjack fishing is done close to the baiting areas.

The skipjack catch by areas, as reported by the fishermen for the years 1948 through 1953, was compiled according to the scheme of area designations used on fisheries chart No. 2 of the Hawaiian Division of Fish and Game (fig. 2). The analysis was made despite discrepancies in the reports of localities of catch, as discussed earlier, for it was felt that although there may be errors in the comparison between the small individual areas (20 square miles) within a year, the errors should be negligible over a number of years and between larger, combined areas.

The localities of capture were divided into major zones: Inshore, within 2 miles of land coastal, 2 to 20 miles; and offshore, beyond 20 miles. The major portion of the catch (about 75 percent) was caught in the coastal zone, as was shown by Royce and Otsu (1955), and the remaining 25 percent of the catch came almost entirely from the offshore zone; the inshore zone contributed an insignificant amount to the total annual catch (fig. 5).[1]

Examination of skipjack catches with respect to distance offshore shows that, except for 1952 catches from the coastal zone remained fairly constant for the years 1948 to 1953, and ranged from 5.3 million to 8 million pounds. Figure 5 suggests that a total of 8 million pounds per year may be the maximum catch that can be harvested from this zone with the present fishing intensity, as implied by the successful years of 1951 and 1953 when 7.7 million and 8.0 million pounds were caught. If this assumption is correct, any increase in the total annual landings must come from increased catches in the offshore zone.

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[1] There are some discrepancies in the figures between the total catch and the totals of the three zones because of the rounding off of the catches into thousands of pounds and the omission of some catches from unidentified areas.

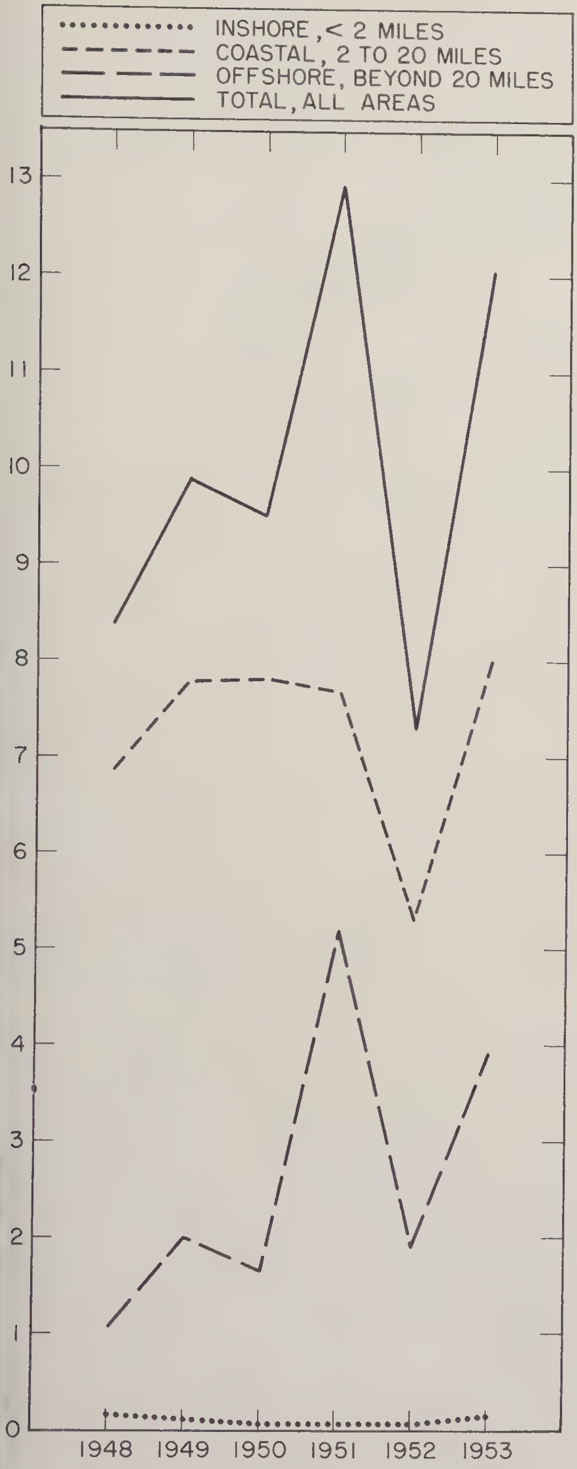
In general, catches from the offshore zone are closely correlated with the catches from all areas (fig. 5). In the record year of 1951, 40 percent of the total catch was taken in the more distant zone and in 1953, 32 percent, whereas during other years not more than 26 percent of the total catch was taken there.

About 90 percent of the annual catch from the offshore zone is obtained from areas between Oahu and Kauai (fig. 6, solid area) and around Oahu, Molokai, and Maui (fig. 6, hatched areas). This distribution of the catch is probably associated with the fact that the majority of the sampans in the fishing fleet are based on Oahu and Maui.

The offshore zone was subdivided into three major regions: Kauai Channel, Oahu-Molokai-Maui, and all other areas, in order to ascertain, if possible, which were the principal localities associated with the major fluctuations in annual catch (fig. 7). The total catch in the offshore zone closely parallels the catch from the region around Oahu-Molokai-Maui. Thus, it appears that the success of a fishing year depends to a large extent on the landings from this particular region.

According to the catch reports, the coastal zone around Oahu was the most productive in the Hawaiian fishery. The skipjack catch from each of the statistical areas (fig. 2, Nos. 420–429) within this zone have ranged from 99,000 to 1 million pounds per year. This apparent concentration of skipjack is probably related in part to the distribution of the fishing fleet on Oahu and in part to the location of the major baiting grounds.

An examination of all areas in the Hawaiian fishery averaging over 100,000 pounds of skipjack per year showed that (1) the best summer catches were made in areas 422 through 427, area 455 off Oahu, and area 125 off Hilo, Hawaii; (2) consistent catches without any pronounced increase during the summer months were made in areas 331, 332, 328, and 428 between Oahu and the Molokai-Lanai area, and area 122 off Kawaihae Bay, Hawaii; and (3) winter landings were relatively higher from the protected lee of the islands, especially areas 328 off Lanai, 423 off Waianae, Oahu, and 122 off Kawaihae Bay.



URE 5.—Skipjack catch by zones and total catch from all areas.

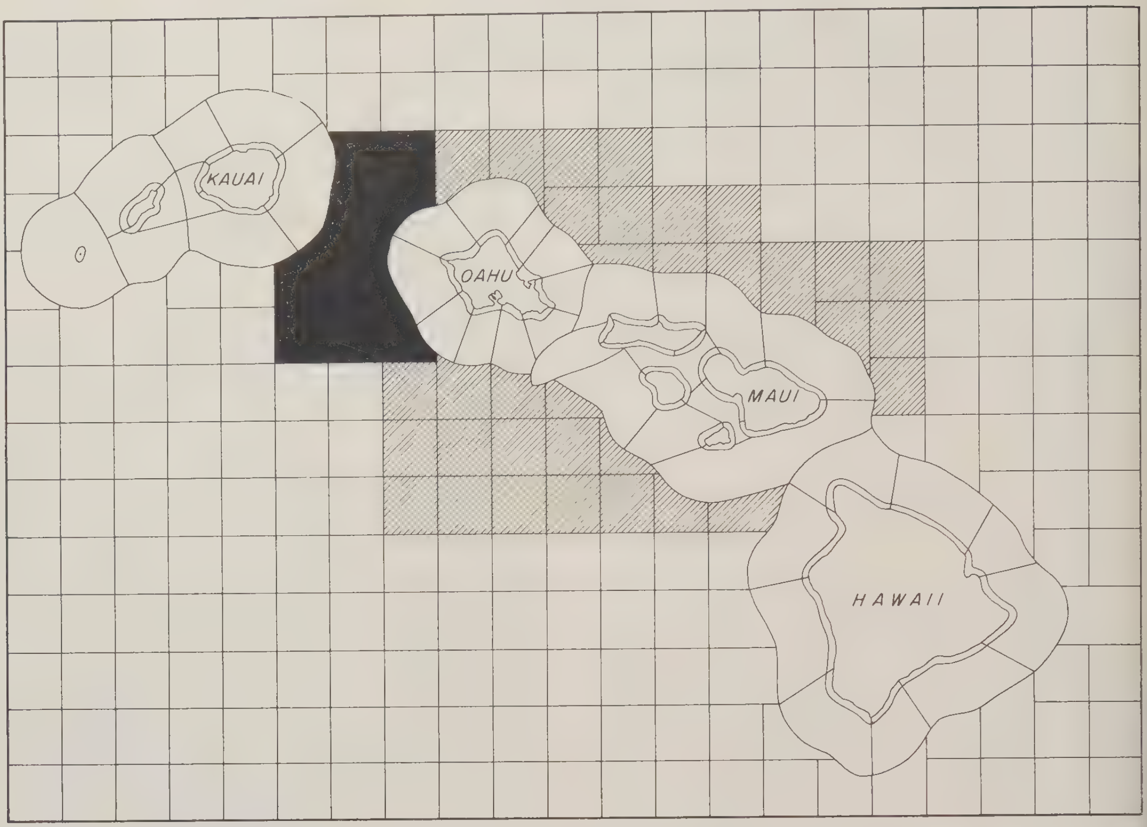


FIGURE 6.—The major offshore fishing zones between Oahu and Kauai (solid area) and around Oahu, Molokai, and Ma
(hatched areas), Hawaiian Islands.

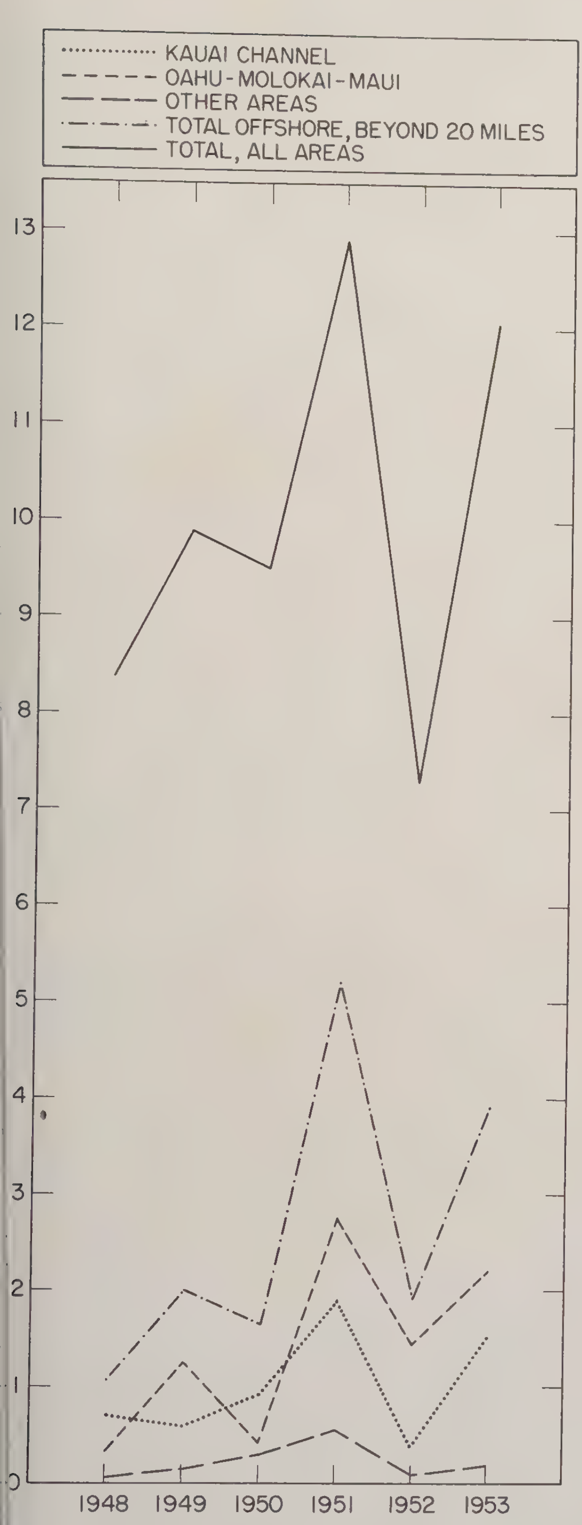
During the poor skipjack season of 1952, catches from the coastal zone showed a decline for Oahu and an increase for Kauai. The increase in the catch from Kauai, however, was insufficient to offset the drop in the catch from Oahu, resulting in a net decrease in the catch from all coastal zones. There was also a decrease in catch from the offshore zone, but the catch was still higher than the previous lows from the same zone for 1948 and 1950 when the annual landings amounted to 8.4 million and 9.5 million pounds, respectively, as compared with 7.3 million pounds for 1952. There were 3 productive areas (averaging over 400,000 pounds per year) during the poor year of 1952 that showed an increase in catch over the same areas for the best postwar year, 1951. These localities were all within 20 miles of land: area 125 off Hilo, and areas 331 and 328 southwest of Molokai and Lanai.

The region that shows the most promise of potentially greater productivity is in the offshore zone north of Oahu, Molokai, and Maui, but still within the range of the fishing fleet. The presen catches are probably not indicative of the abundance of skipjack in these northern waters becaus of the low effort expended there, related to generally unfavorable weather conditions. The catc records over the 6-year period show good catche for 1 or 2 years, with no catch reported durin other years. The areas to the south of Oahu (fig. Nos. 351, 451–453) have shown evidence of increased production during the last 2 or 3 years.

With the type of vessel in use at present in th skipjack fishery, the most promising immediat prospect of increasing the catch is to exert mor effort in the offshore zones, especially aroun Oahu, Molokai, Maui, and Lanai. The exploitation of these areas might be most feasible durin the usual offseason period, when fish are no abundant in the coastal zones.

INDEX OF RELATIVE ABUNDANCE

A general measure of the catch per unit of effor in the skipjack fishery on an annual basis can bes



RE 7.—Skipjack catch from the three major divi- ns of the offshore zone; from all areas beyond 20 es; and the total catch from all areas: inshore, stal, and offshore.

be obtained from the reports of the individual fishing trips turned in by the fishermen. A critical examination of the catch reports is necessary, however, to separate the effort expended in catching bait from the actual fishing effort.

In order to obtain some index of relative skipjack abundance, the average catch per productive fishing trip (1 day's fishing) was calculated for one sampan for a number of years and compared with the average catch for a number of other sampans for the same years. Unfortunately, as previously mentioned, the completely unproductive trips could not be accounted for in the analysis due to inadequate records.

Six sampans, A, B, C, D, E, and F, were originally selected for analysis on the basis of reliable catch reports turned in, as determined by comparison of catch and interview data. Two additional sampans, G and H, were included because their catch records showed that the number of trips reported was comparable to the number reported by the others, although their reports could not be verified for reliability, since no interview records were available. All of these vessels were based on Oahu and were representative of the local fishing fleet insofar as size of vessel was concerned.

The original catch records were examined for the years 1948 to 1953, and the average catch per trip was selected as the catch per unit of effort. The criterion used in the selection of the catches was agreement between bait-catch date and fish-landing date, both of which appear on each report sheet (appendix figs. 3 and 4, pp. 275-6). Catches used in this analysis were those in which (1) the landing date and bait-catch date were identical, (2) the landing date immediately followed a baiting date, or (3) the landing date immediately followed another landing date that was preceded by a baiting period during which bait was caught in sufficient quantities for two or three successive fishing trips.

A comparison of the skipjack catch of the selected vessels shows that, as expected, the best individual catches were made during the months of highest total catch for the fishery, and the larger vessels generally made the best catches (table 6). The relation between catches by boats and years, as shown by both the catch of individual boats and the average catch of the eight vessels (table 7), suggests a situation in the fishery different from that indicated by the total landings. All of the selected vessels with the exception of one (G) enjoyed their most productive trips during 1951, but the catches of only four of the vessels (A, B, D, and H) showed that 1952 was an unusually poor year. Furthermore, even during the relatively good year of 1953, one of the boats (F) made its smallest catch of the period.

TABLE 6.—*Average catch of skipjack per trip of eight vessels, by season, 1948–53*

[Trip=1 day's fishing]

Vessel	Registered length (feet)	Average catch (in pounds) during—		
		Offseason [1]	Preseason and postseason [2]	Main season [3]
A	68	3, 252	4, 936	7, 405
B	67	2, 224	3, 832	7, 316
C	80	3, 841	6, 507	11, 704
D	62	2, 773	3, 497	5, 701
E	77	2, 971	5, 768	8, 409
F	74	3, 080	4, 706	7, 614
G	60	2, 010	3, 037	6, 653
H	70	2, 411	3, 476	5, 468

[1] January–March and November–December.
[2] April–May and September–October.
[3] June–August.

TABLE 7.—*Average catch of skipjack per trip of eight vessels, by years, 1948–53*

[Trip=1 day's fishing]

Vessel	Average catch (in pounds) in—						
	1948	1949	1950	1951	1952	1953	All years [1]
A	5, 037	7, 494	4, 550	9, 705	4, 450	6, 068	6, 070
B	4, 261	5, 903	4, 641	7, 436	3, 683	4, 681	5, 142
C	6, 106	8, 197	6, 871	10, 174	7, 104	10, 053	8, 161
D	3, 411	4, 284	3, 931	6, 077	3, 391	4, 229	4, 230
E	5, 257	8, 259	5, 014	10, 894	5, 265	6, 312	6, 767
F	------	6, 747	6, 110	9, 883	4, 771	4, 724	6, 319
G	2, 954	4, 064	3, 797	4, 968	3, 174	5, 624	4, 159
H	3, 701	5, 132	3, 647	6, 279	2, 928	3, 938	4, 259
Average, all vessels [1]	4, 393	6, 235	4, 878	8, 348	4, 440	5, 788	5, 696

[1] Based on total catches and corresponding number of trips.

The average skipjack catches of the eight vessels (based on a total of about 500 trips per year) were compared with the total annual landings (fig. 8), for the period 1948 to 1953. The chief difference between the two curves based on these data is the reversal in rank for the catches of 1949 and 1953. According to the catch-per-trip data, skipjack were in greater abundance in 1949 than in 1953; however, the records indicate a longer fishing season in 1953, and a corresponding larger catch that year. The total catch amounted to 12.1 million pounds in 1953, as compared with 9.9 million pounds in 1949. Since the average weig of fish taken was about the same in both year the relative abundance of skipjack may have bee greater in 1949 than in 1953.

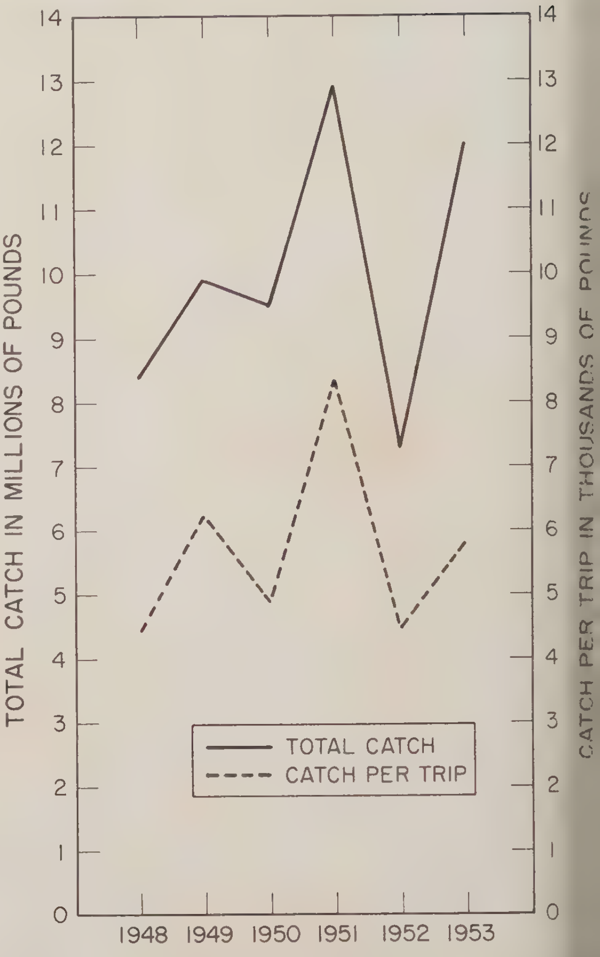


FIGURE 8.—Comparison between total annual landin and average catch per trip of eight sampans, 1948–53.

PREDICTING THE CATCH

An examination of the catch by months for th postwar years has produced some evidence of a correlation between the catch in certain early months of the year and in the main season. There is also an indication that the total catch of skipjack in any one year is associated with the siz of the year-class 2 or 3 years earlier.

Employing a correlation analysis and the catch records (weight sold) for 8 years, 1946 to 1953.

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[2] 1946 and 1947 were not comparable with the more recent years with respec to the number of vessels in the fleet, and during 1953 a greater amount effort was expended; nevertheless, the catch records for these years wer included in this analysis to increase the number of observations.

e following comparisons were made: (1) First months with remainder of the year, (2) April th May through September, (3) April with ay through December, (4) April with the re- ining 11 months (January to March and May December) of the year, (5) first 6 months with t 6 months of the year, and (6) last 3 months ctober to December) with the subsequent year. all comparisons except the first, which gave a nsignificant negative correlation, the results wed nonsignificant positive correlations. The hest correlation value ($r=0.667$, $P=$ca. 0.06) ulted from the comparison of catches for April l the remaining 11 months of the year; this parent relation, admittedly tenuous, is worthy closer study when more data are available.

rock (1954, p. 95), in his analysis of skipjack gth frequencies, states that,

> it is assumed that these modal groups [40–50 cm., 72 cm., 79–80 cm.] represent year-classes, the following rpretation of the length frequency data may be made: ome age, perhaps 1 or 2 years, an age group or year- s is first taken in significant amounts by the fishermen ng the summer fishing. By the second summer, age group, at a length of 70 to 75 centimeters, is again n and, as a matter of fact, is the size group most rly sought by the fishermen. This year-class appears n in the catch during the third summer but cannot aced thereafter with any certainty from the available .

he comparison between length frequencies of aiian skipjack (Brock 1954, fig. 1) and the ual catch in weight indicates that larger hes are made when the greater percentage he catch consists of the 68- to 72-cm. size p. Assuming that the seasonal abundance ipjack in the local fishery is associated with ning, and that the 68- to 72-cm. size fish n their second or third year, the abundance sh for every other year or every third year should be significantly correlated, neglecting, of course, the possibilities of catastrophic larval mortality and any oceanographic changes affecting the return of the spawning stock.

The correlation coefficient resulting from a test of the hypothesis that the annual catches of skipjack (1946–53) from every other year are positively related showed some correlation but was not statistically significant ($r=0.518$, $P>0.05$), and the comparison of the catches from every third year showed no correlation ($r=0.029$).

The possibility of making worthwhile predictions of seasonal or annual catches from preseason data seems doubtful at the present time, although it should be reexamined when a longer time series of catch data is available. The chief hope of prediction probably lies in relating fluctuations in the availability of skipjack with fluctuations in the physical, chemical, or biological properties of the environment.

THE BAIT FISHERY

The local skipjack fishery is primarily dependent on the live-bait supply, and the crew of a sampan may spend up to 50 percent of its time fishing for bait. Baiting, both day and night, may continue for 2 or 3 days before a sufficient supply can be accumulated for 1 day's fishing. Two species are of major importance in the local live-bait fishery: the anchovy or nehu, *Stolephorus purpureus* Fowler and the silverside or iao, *Pranesus insularum* (Jordan and Evermann). The nehu makes up about 92 percent of the catch; the iao most of the remainder. The postwar records show that the annual bait production has averaged about 36,000 buckets,[3] with a maximum of about 42,000 buckets caught under the present fishing intensity (table 8).

TABLE 8.—*Bait-fish catch, by buckets, 1946–53*

[1 bucket=7 pounds of fish; data from Hawaiian Division of Fish and Game]

Locality	1946	1947	1948	1949	1950	1951	1952	1953
y (nehu):								
	16,728	21,690	23,868	27,246	22,360	18,646	14,744	21,470
	6,804	5,448	10,974	7,344	[1] 10,066	[1] 9,537	[1] 6,056	[1] 8,890
ii	1,410	1,470	3,708	2,664	1,671	3,292	3,103	3,718
	72	534	762	108	526	1,213	1,031	1,614
ai	204	150	468	288	738	582	602	76
			36					
			24				10	36
l	25,218	29,292	39,840	37,650	[1] 35,361	[1] 33,270	[1] 25,546	[1] 35,804
ait fish (all islands)	642	1,458	2,196	1,908	[1] 4,277	[1] 7,221	[1] 4,261	[1] 1,878
id total	25,860	30,750	42,036	39,558	[1] 39,638	[1] 40,491	[1] 29,807	[1] 37,682

usted bait catch (see pp. 268 and 269).

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[3] A bucket is approximately equal to 7 pounds of fish.

CATCH STATISTICS

Methods of Collection

Since July 1947 the method of reporting has been based on a system whereby the fishermen turn in a combined skipjack and bait report for each successful fishing trip (but not necessarily for each baiting operation), noting the following information on bait: Date of catch, locality, amount of bait caught, and amount used. These reports are edited, coded, and transferred to punch cards which are in turn transcribed to IBM summary sheets. Unlike the commercial fish catch, the bait catches are not published for circulation; therefore the annual catches by islands must be obtained from IBM record sheets or other summarized records. The interview records have also been a source of information concerning bait catches since July 1949.

Completeness and Accuracy

In order to estimate the proportion of the bait catch reported, an analysis similar to that made on the skipjack catch was followed by comparing interview records and catch reports (table 9). The procedure was slightly modified under the assumption that the catches as reported in the interview records were reasonably accurate (1) because the optimum capacity of the bait boxes was known, and (2) because of the close proximity of the bait-catch date to the interview date.

Interview records (table 9, col. 1) were first compared with corresponding catch reports (col. 2) to determine the accuracy of the catch reports (col. 3). All bait catches as reported in interview records (col. 4) were then checked against a reported catches (col. 5) in order to compute th percentage of the catch reported (col. 6). Th reported catch included all the correspondin catches (col. 2) plus the few instances in which th amount of bait caught, as reported in the cat records, was not the original amount caught, bu the amount left over from a previous trip. I such instances, the original amount caught wa usually not reported, and errors such as this coul be detected only by the comparison of intervie records and catch reports. All duplicated o partially duplicated catches that could be recognized by an examination of a sequence of catc reports were omitted from this analysis.

Comparison of columns 3 and 6 in table shows that the fishermen made a fairly accurat bait-catch report when they turned in the reports but frequently they failed to make the bait reports. Analysis showed that each individual bai report may be 91 percent complete, but that onl about 75 percent of the total catch was actuall accounted for.

There were other irregularities, too. Examination of the summary records showed an apparen marked increase in bait catch reported for Ma waters from 1950 to 1953. This increase coincided with the introduction of a new record for during the summer of 1950. The new forms wer very similar to the old except for the changin of the unit of bait measurement from box[4] bucket (appendix figs. 3 and 4, pp. 275–6). Man of the bait catches from Maui during this perio

TABLE 9.—*Comparison of interview records and catch reports for the bait fishery, 1952*

[Catch, by buckets]

Month	1 Bait catches shown on selected interview records	2 Bait catches shown on catch reports corresponding to interview records in col. 1	3 Percent of bait catch reported in catch reports	4 Bait catch shown on all interview records	5 Bait catch shown on all catch reports corresponding to interview records in col. 4	6 Percent of total catch reported
May	93.5	84.0	89.8	148.5	84.0	55
June	509.0	467.0	91.7	585.0	473.0	80
July	523.0	494.0	94.4	798.0	504.0	62
August	757.5	694.0	91.6	800.5	713.0	89
September	742.0	665.0	89.6	835.0	683.0	81.
October	632.0	567.0	89.7	858.0	599.0	69.
November	66.0	56.0	84.8	146.0	56.0	38
Total	3,323.0	3,027.0		4,171.0	3,112.0	
Average			91.1			74

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[4] One box is equivalent to 6 buckets of bait.

e recorded on the old form, primarily because Maui vessels were slow to change to the new n. It is believed, however, that most of the sels, though they used the old form, actually orded their catches in buckets in compliance h the new regulations. For instance, entries h as 25 boxes of bait for a fishing trip on a pan with only 6 bait boxes were numerous ing this period. However, if these statistics, recorded in the IBM summary sheets, are verted to buckets (6 buckets per box) in order nake comparisons with recent years, the totals ear unreasonable.

or this study, all the bait caught from Maui ers during the period from 1950 through 1953 considered in terms of buckets regardless of ther or not it was reported as boxes and rdless of the form used. This could lead to nderestimation of the catch, because some of vessels may actually have meant boxes, icularly when using the old form. There is possibility of this adjustment affecting that ion of the bait reported from Maui by non- i sampans (primarily those from Oahu), use they quickly adopted the new form. e underestimation of the catches by Maui ls must remain, but the general level of the es they reported was usually larger than e number of bait boxes on board), suggesting they were complying with the new regula- although using the old form.

BAITING AREAS

e distribution of bait catch by islands e 8) shows that Oahu and Maui are the r sources of nehu, as averages of 64 and 25 nt, respectively, of the total catch were ted from these two islands. The important g grounds on Oahu are Kaneohe Bay, Harbor, and Honolulu Harbor, and the of the catch comes from the first two locali- The catch from Pearl Harbor varies accord- the extent of the restrictions placed upon shery by the United States Navy and is y less than that taken from Kaneohe Bay. aui, about 86 percent of the nehu catch is ed from Maalaea Bay and the Kihei region. slands of Hawaii, Kauai, and Molokai con- e lesser amounts to the fishery, largely be- of the limited extent of the baiting grounds. Oahu, the island supporting the most intensive bait fishery, the annual catch has fluctuated between 15,000 and 27,000 buckets during the period 1946 to 1953. The increase in the catch in 1947 (see table 8) may have been due in part to an increase in the number of sampans operating during the latter part of the year. The slight increase during the following year (1948) was also probably related to the larger number of boats in operation throughout the year. Since the number of vessels remained fairly constant after 1947, the years 1948 to 1953 may be considered comparable insofar as fishing effort for bait is concerned. The considerable increase in the 1949 bait catch may be attributed to the partial lifting of restrictions in Pearl Harbor, making more baiting grounds available to the fishermen. The island of Kauai has shown a general increase in bait catches compared to earlier years, and so has Molokai, except for the year 1953.

The fluctuation in the bait catch on the different islands, aside from availability and abundance, may be due in part to the geographical position of the major islands. The island of Hawaii with only two principal baiting grounds (Kawaihae-Kona region and Hilo Harbor) may be considered as a separate area, whose bait resources are utilized mainly by its own sampans. The islands of Kauai, Oahu, Molokai, and Maui may be grouped together because of the practices followed by the sampans based there. Sampans from Oahu, because of their central location, may bait in Kauai, Molokai, or Maui, as well as Oahu. The sampan stationed in Kauai, on the other hand, may bait in Kauai and Oahu but probably would not exploit the baiting grounds in the more distant island of Maui to any appreciable extent. Likewise, the boats from Maui may bait in Maui, Oahu, or Molokai but will do little baiting, if any, in Kauai, and although Maui is closer to Hawaii than to Oahu, the Maui sampans will favor Oahu because the opportunities of catching bait and possibly unloading their skipjack catches are better there than in Hawaii. Hence, the bait catch from the island of Hawaii has remained constant because of the more or less isolated nature of its fishery, whereas the catches from Kauai and Molokai may have been affected by the amount of effort directed to these islands, depending on the abundance of bait in the major baiting grounds of Oahu and Maui.

SIGNIFICANCE OF BAIT PRODUCTION

On the basis of the foregoing information on bait statistics and the analysis of the completeness of the reported catch, the maximum annual yield of bait may be reestimated to be closer to 50,000 or 60,000 buckets (table 10) than to the reported catch of 42,000. Since it has been found from previous studies that there is about 30 percent mortality of bait associated with the initial period of capture (Hawaii Commissioners of Agriculture and Forestry, 1952) and the reported amount of bait caught may be only 75 percent complete, the total annual bait catch as reported may be roughly comparable to the amount actually utilized in the fishery.

Table 10.—*Reported and estimated annual bait catch, 1946–53*

[Reports assumed to be 74.6 percent complete; in thousands of buckets]

Year	Reported catch	Estimated catch
1946	25.9	34.7
1947	30.8	41.3
1948	42.0	56.3
1949	39.6	53.1
1950	39.6	53.1
1951	40.5	54.3
1952	29.8	39.9
1953	37.7	50.5

Table 11.—*Relation between live-bait and skipjack catches, 1946–53*

[1 bucket=7 pounds of fish]

Year	Bait catch (buckets)	Skipjack (pounds)	
		Sold	Catch per bucket
1946	25,860	5,630,251	217.7
1947	30,750	5,591,536	181.8
1948	42,036	8,336,951	198.3
1949	39,558	9,864,009	249.4
1950	39,638	9,481,302	239.2
1951	40,491	12,874,274	318.0
1952	29,807	7,264,019	243.7
1953	37,682	12,030,537	319.3

The availability of bait may, in certain years, be a limiting factor in the skipjack fishery. A comparison of the annual bait and skipjack catches (table 11) shows that the catch of skipjack per bucket of bait was higher for 1951 and 1953 than for any of the other years. Apparently, these 2 years represented periods of maximum efficiency with respect to utilization of bait; furthermore, the interviews with fishermen indicated that bait was a limiting factor during these years. During 1947 and 1948, when bait efficiency was low, the amount of bait probably had little effect on production.

An evaluation of the effect of variations in the bait supply is difficult, however, because of num erous other factors affecting the annual skipjac landings. The fish may be equally abundant i different years, but their vulnerability due t biting readiness (slow or fast biting) may differ thus, more bait may be needed to catch an equa amount of fish in one year than in another. Also the fish may differ in size between years; thus the predominance of smaller fish in the fishery would require the use of more bait to catch a equal weight of fish. But, regardless of the efficiency in the utilization of bait, the possibilities of obtaining larger skipjack catches at the present time are more favorable when more live bait is available. Brock[5] has discussed the monthly variations in the weight of skipjack caught per bucket of bait used, and showed that larger catches are obtained during the summer months, when the bulk of the annual catch is landed.

SUMMARY

1. All existing catch records of the Hawaiia skipjack fishery for the period 1900 to 1953 hav been brought together in this report. The annua skipjack catch for the more recent years, 1948 t 1953, ranged from 7 million to 13 million pounds and accounted for 50 to 70 percent by weight o all fish landed in the local commercial fishery.

2. Comparison of interview and catch record indicated that the 1945–53 skipjack catch sta tistics were approximately 94 percent complete.

3. Because of the variation in size compositio of the catch, the apparent relative abundance o skipjack depends on whether the total weight o the total number of fish in the catch is used. I order of decreasing catch by weight, the year may be arranged as follows: 1951, 1953, 1949, 1950, 1948, and 1952. In terms of catch by number of fish, the order becomes 1951, 1953, 1948, 1950, 1952, and 1949.

4. Because of the convenience to the sampans of fishing close to home ports and to baiting grounds, about 75 percent of the skipjack catch

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[5] Mimeographed statement "Explanation of tables and figures concerned with use of bait for the years 1950 to 1954," Hawaii Commissioners o Agriculture and Forestry, Division of Fish and Game, Honolulu.

ing 1948 to 1953 was taken within 20 miles of
d. The catch within this coastal zone has re-
ined relatively constant from year to year
th the exception of 1952); large increases in the
ual catch have been the result of increased
ches from the offshore zone.

. The average skipjack catch in weight per
was used as a possible index of relative abun-
ice and the catch in decreasing order may be
anged as follows: 1951, 1949, 1953, 1950, 1952,
1948.

. Attempted predictions of the yearly skip-
k catch based on past catch statistics alone are
ittle value, partly because of the relative short-
s of the period under observation. More re-
le predictions may be possible in the future
en the relation between fish stocks and environ-
nt can be ascertained.

. The expansion of the Hawaiian skipjack
ery has been restricted primarily by the short-
of bait. The principal bait used is nehu
lephorus purpureus), an anchovy, and the
n sources of supply are the inshore waters of
u and Maui.

An examination of interview records and
h reports indicated that only 75 percent of the
l bait catch was reported. In view of the high
mortality (about 30 percent), the reported
catch, averaging about 36,000 buckets
,000 pounds) a year, may be a close approxi-
ion of the amount actually used in fishing.

The skipjack catch per bucket of bait (7
nds) ranged from a low of 182 pounds in 1947
high of 319 pounds in 1953.

. Specifications of each full-time skipjack
pan in the Territory of Hawaii for 1953 are
ented in the appendix to aid in evaluating
re changes in catch that may be related to
ges in vessel design.

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APPENDIX

In respect to information listed in the following table, the basic specifications of the full-time Hawaiian skipjack sampans fishing in 1953 were taken primarily from the files of the United States Customs, Marine Division, unless otherwise stated. The various registered measurements, as defined in Merchant Vessels of the United States (United States Treasury, 1952) are as follows:

Registered length "is the length measured on the top of the tonnage deck from the fore part of the outer planking or plating at the bow to the after part of the sternpost of screw steamers and to the after part of the rudderpost of other vessel The registered length is not usually the same the overall length nor the load-water-line length.

Registered breadth "is the breadth at its wide part measured from the outer side of the plankin or plating on one side to the corresponding poin on the opposite side."

Registered depth "is the depth measured fro the inner side of the tonnage deck, amidships, t the bottom of the hold. The depth is not th draft of a vessel."

Appendix Table 1. *Basic specifications of the full-time Hawaiian skipjack boats (sampans) fishing in 1953*

[All boats with single screw, diesel engine(s)]

Name of boat	Official number	Island	Tonnage		Registered dimensions			Type of hull	Date built	Number in crew	Engine	Horsepower	Bait boxes [1]		
			Gross	Net	Length (ft.)	Breadth (ft.)	Depth (ft.)						Number	Average effective volume (gal.)	Type o circulatio
Amberjack	252808	Maui	61	41	70.0	16.0	7.3	Steel	1947	15	General Motors	330	6	1,085	Forced.
America Maru	231965	Oahu	54	33	71.5	14.8	8.8	Wood	1930	10	Gray Marine	330	6	685	Open flo
Bluefin	238180	do	31	19	66.1	13.1	5.9	do	1927	10	do	225	6	558	Do
Bonito	239892	do	37	19	67.7	13.8	6.7	do	1940	10	Atlas Imperial [2]	155	6	580	Do.
Broadbill	238206	do	36	11	66.8	12.8	6.0	do	1926	10	General Motors	300	6	614	Do.
Buccaneer	253735	do	68	40	69.4	16.9	7.8	Steel	1947	12	do	330	6	1,232	Forced
Constance C	238251	do	44	21	60.5	13.2	7.2	Wood	1930	9	Gray Marine [2]	230	6	736	Open f
Corsair	257593	Hawaii	51	34	65.0	15.2	7.2	do	1949	12	Atlas Imperial	160	6	1,000	Do.
Darling Dot	254011	Oahu	77	52	80.5	16.9	6.8	do	1947	14	do	250	6	1,297	Do.
Dolphin	239501	Maui	33	17	66.8	12.7	7.3	do	1928	8	Gray Marine [2]	110	6	688	Do
Electa	237448	Oahu	47	23	72.1	13.5	7.7	do	1938	11	Union	150	6	854	Do.
Helena II [3]	239190	Maui	29	13	65.8	12.3	6.2	do	1928	11	Gray Marine	225	6	575	Do.
Kiyo Maru [4]	238307	Oahu	27	18	58.3	11.8	5.6	do	1937	7	Union	150	6	600	Do.
Marlin	238043	do	44	18	70.0	13.5	5.9	do	1935	11	Caterpillar [2]	275	6	670	Do
Maui Maru [5]	239364	Maui	29	14	67.3	13.0	5.7	do	1929	9	Gray Marine	165	6	577	Do.
Momi	238185	Oahu	31	15	61.9	12.5	5.5	do	1934	8	Caterpillar	115	6	574	Do.
Neptune	237230	do	46	20	71.5	13.6	6.6	do	1938	10	Atlas Imperial	250	6	839	Do.
Olympic	252822	Maui	38	25	66.8	14.5	6.0	do	1947	10	Gray Marine	450	6	708	Do.
Orion	251045	Oahu	51	23	76.6	16.2	6.7	do	1946	12	Caterpillar [3]	400	6	1,064	Do.
Sailfish	230892	do	51	35	74.4	15.1	6.5	do	1931	10	Atlas Imperial	160	6	1,135	Do.
Skipjack	238265	Hawaii	39	19	71.9	13.9	6.3	do	1928	11	Caterpillar [2]	165	6	785	Do
Sooty Tern	253367	Maui	45	31	72.8	14.9	6.2	do	1947	13	Gray Marine [2]	330	6	1,127	Do.
S. T. Uruma [6]	252940	Oahu	47	32	72.3	15.7	5.1	do	1947	13	Atlas Imperial	250	6	891	Do.
Sunfish	238284	do	32	15	69.8	12.6	5.8	do	1926	10	Gray Marine [2]	225	6	664	Do.
Tradewind	260364	Kauai	54	34	72.6	15.5	7.3	do	1950	11	Atlas Imperial	200	6	873	Do.
Yellowfin	238314	Oahu	33	17	59.3	12.6	5.9	do	1928	10	Gray Marine	225	6	576	Do.

[1] From unpublished report "Measurements of bait tanks on Territory of Hawaii aku boats" by A. L. Tester, 1949.

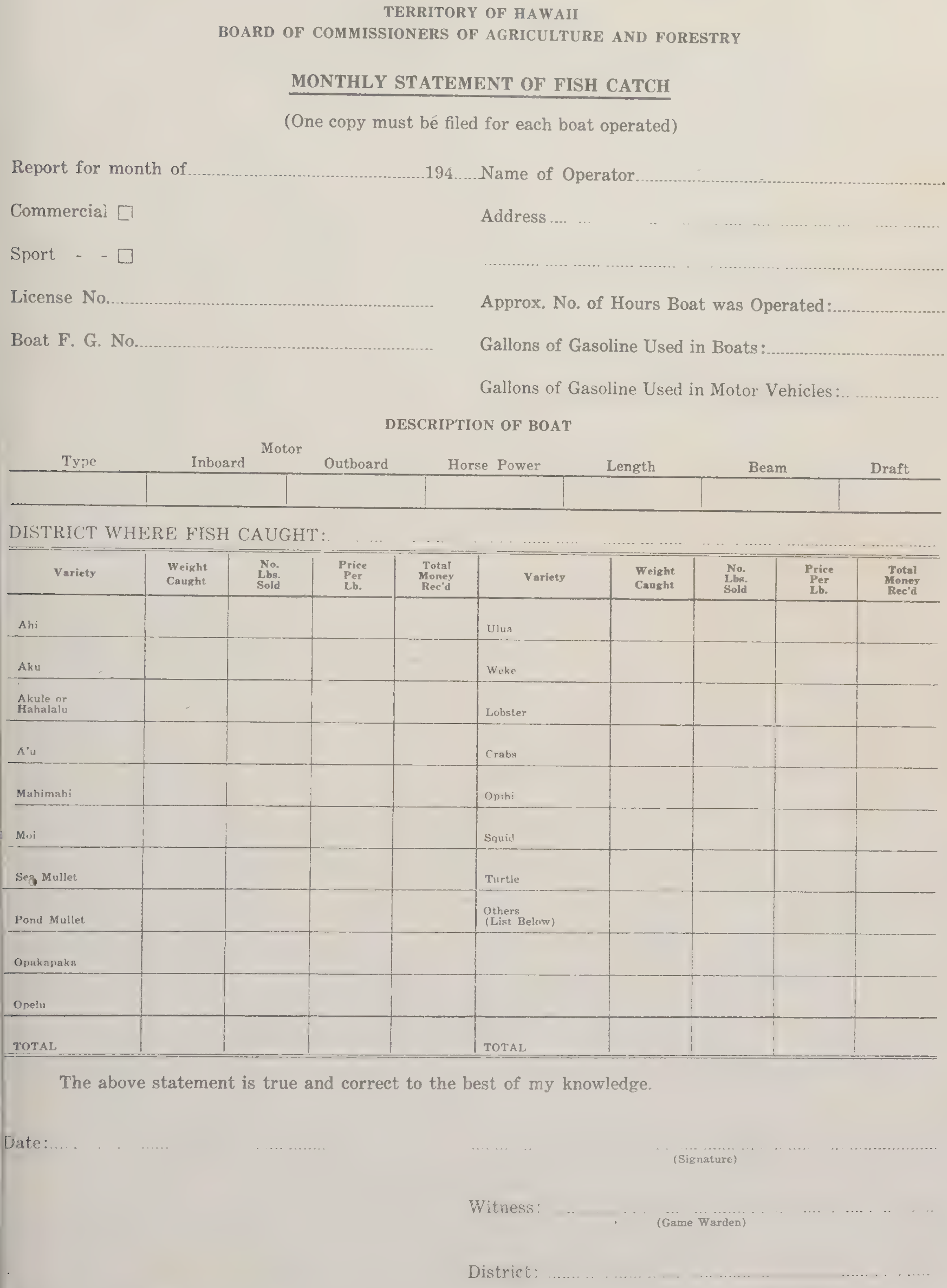
[2] From files of the Hawaiian Division of Fish and Game.

[3] Changed to *Ooji* in 1954.

[4] Changed to *Holokahana II* in 1954.

[5] Changed to *Helena II* in 1955.

[6] Changed to *Kilohana* in 1954.



TERRITORY OF HAWAII
BOARD OF COMMISSIONERS OF AGRICULTURE AND FORESTRY

MONTHLY STATEMENT OF FISH CATCH

(One copy must be filed for each boat operated)

Report for month of..194..... Name of Operator..

Commercial ☐ Address..

Sport - - ☐ ....

License No.. Approx. No. of Hours Boat was Operated:..............................

Boat F. G. No.. Gallons of Gasoline Used in Boats:..............................

Gallons of Gasoline Used in Motor Vehicles:..............................

DESCRIPTION OF BOAT

Type	Motor		Horse Power	Length	Beam	Draft
	Inboard	Outboard				

DISTRICT WHERE FISH CAUGHT:..

Variety	Weight Caught	No. Lbs. Sold	Price Per Lb.	Total Money Rec'd	Variety	Weight Caught	No. Lbs. Sold	Price Per Lb.	Total Money Rec'd
Ahi					Ulua				
Aku					Weke				
Akule or Hahalalu					Lobster				
A'u					Crabs				
Mahimahi					Opihi				
Moi					Squid				
Sea Mullet					Turtle				
Pond Mullet					Others (List Below)				
Opakapaka									
Opelu									
TOTAL					TOTAL				

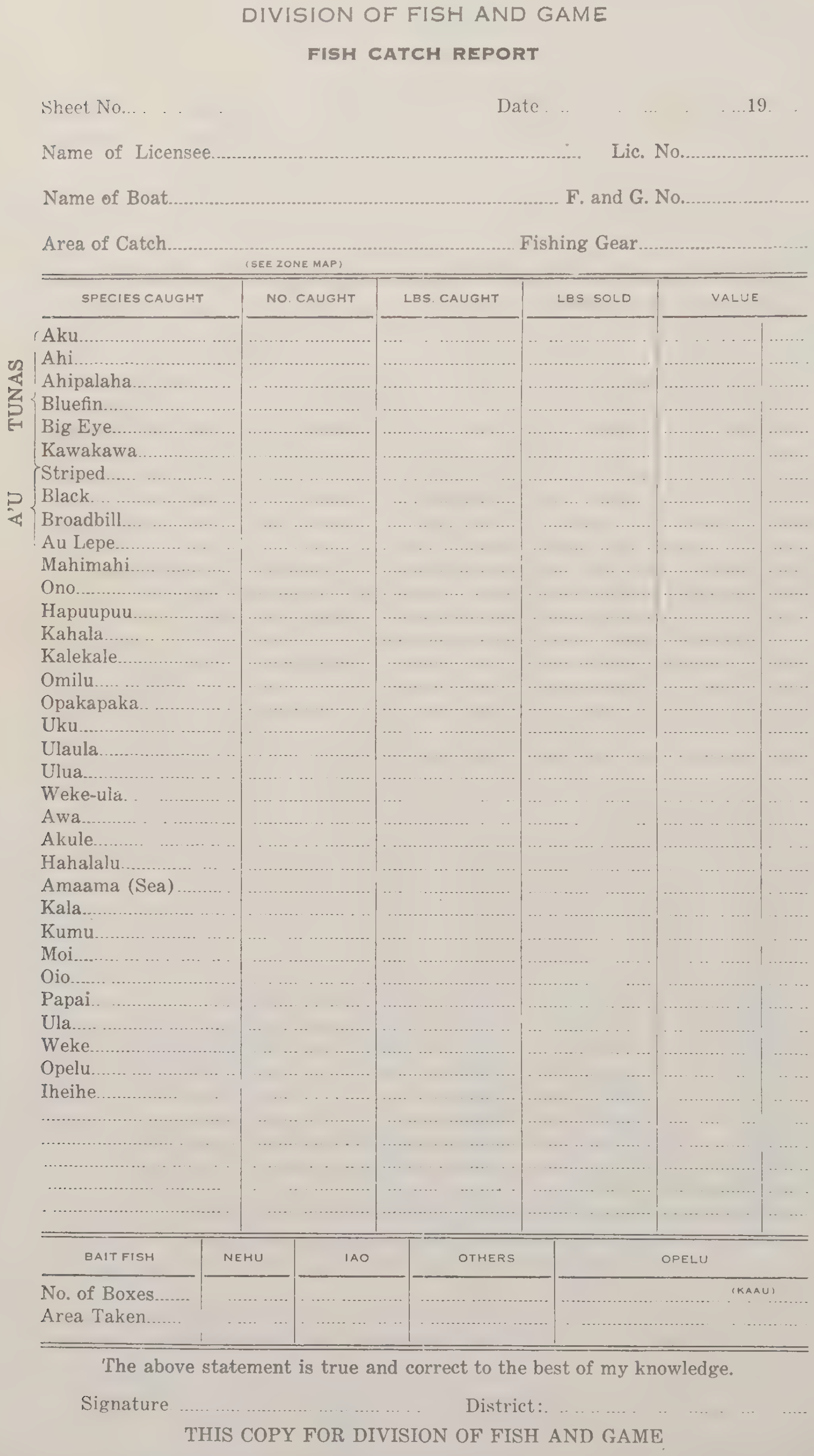
The above statement is true and correct to the best of my knowledge.

Date:.............................. ....
(Signature)

Witness: ....
(Game Warden)

District: ....

DIX FIGURE 1.—Fish-catch report form; introduced in March 1944 as standard form for reporting all types of fishing.



DIVISION OF FISH AND GAME

FISH CATCH REPORT

Sheet No.......... Date................19...

Name of Licensee.................................... Lic. No....................

Name of Boat.................................... F. and G. No....................

Area of Catch.................................... Fishing Gear....................
(SEE ZONE MAP)

	SPECIES CAUGHT	NO. CAUGHT	LBS. CAUGHT	LBS SOLD	VALUE
TUNAS	Aku				
	Ahi				
	Ahipalaha				
	Bluefin				
	Big Eye				
	Kawakawa				
A'U	Striped				
	Black				
	Broadbill				
	Au Lepe				
	Mahimahi				
	Ono				
	Hapuupuu				
	Kahala				
	Kalekale				
	Omilu				
	Opakapaka				
	Uku				
	Ulaula				
	Ulua				
	Weke-ula				
	Awa				
	Akule				
	Hahalalu				
	Amaama (Sea)				
	Kala				
	Kumu				
	Moi				
	Oio				
	Papai				
	Ula				
	Weke				
	Opelu				
	Iheihe				

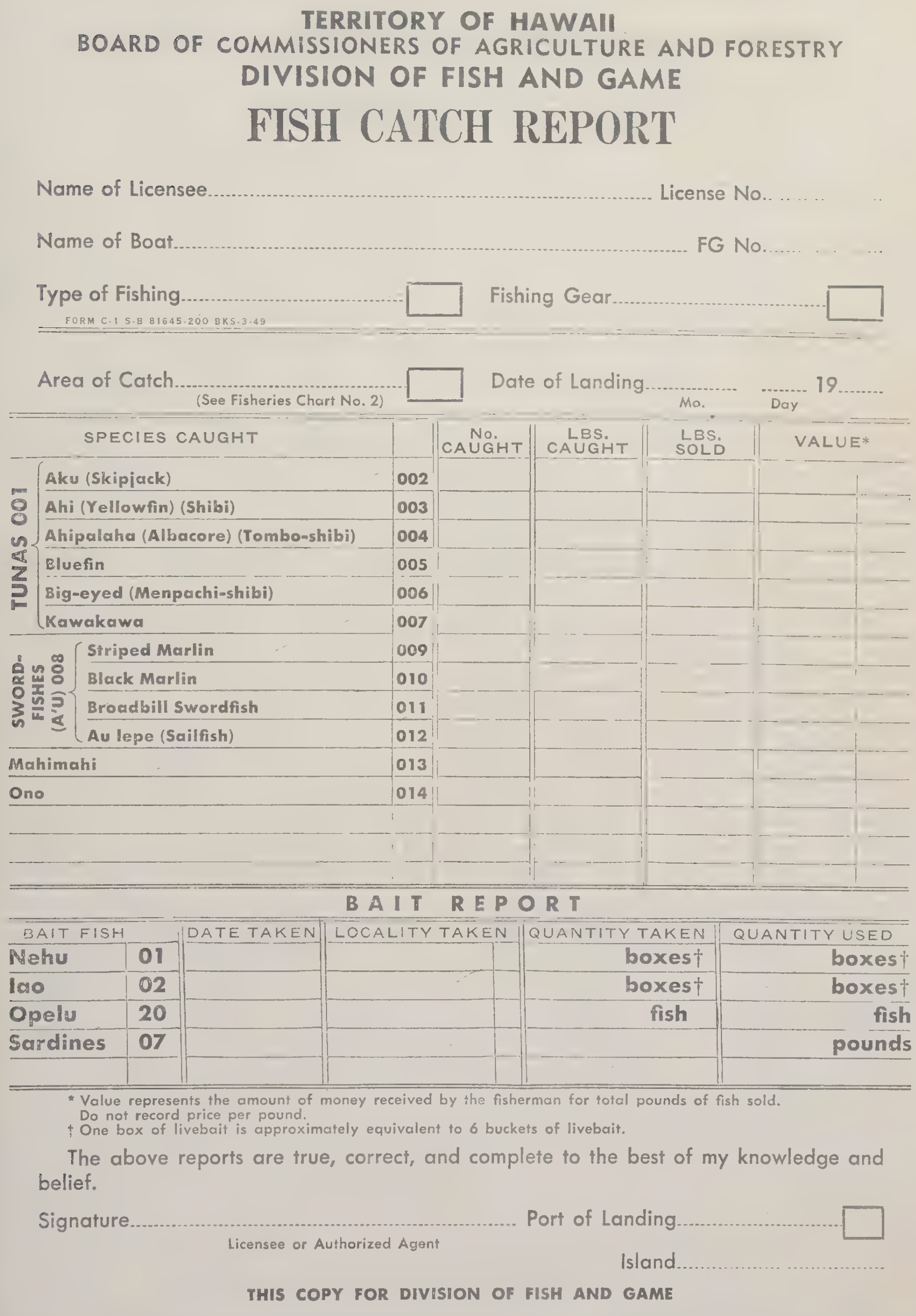
BAIT FISH	NEHU	IAO	OTHERS	OPELU (KAAU)
No. of Boxes				
Area Taken				

The above statement is true and correct to the best of my knowledge.

Signature.................................... District:....................

THIS COPY FOR DIVISION OF FISH AND GAME

APPENDIX FIGURE 2.—Fish-catch report form; introduced in July 1945 as standard form for reporting all types of fishi



TERRITORY OF HAWAII
BOARD OF COMMISSIONERS OF AGRICULTURE AND FORESTRY
DIVISION OF FISH AND GAME

FISH CATCH REPORT

Name of Licensee.. License No.........

Name of Boat.. FG No.........

Type of Fishing........................ ☐ Fishing Gear........................ ☐

FORM C-1 S-B 81645-200 BKS-3-49

Area of Catch........................ ☐ Date of Landing.............. .... 19.........
(See Fisheries Chart No. 2) Mo. Day

	SPECIES CAUGHT		No. CAUGHT	LBS. CAUGHT	LBS. SOLD	VALUE*
TUNAS 001	Aku (Skipjack)	002				
	Ahi (Yellowfin) (Shibi)	003				
	Ahipalaha (Albacore) (Tombo-shibi)	004				
	Bluefin	005				
	Big-eyed (Menpachi-shibi)	006				
	Kawakawa	007				
SWORD-FISHES (A'U) 008	Striped Marlin	009				
	Black Marlin	010				
	Broadbill Swordfish	011				
	Au Iepe (Sailfish)	012				
Mahimahi		013				
Ono		014				

BAIT REPORT

BAIT FISH		DATE TAKEN	LOCALITY TAKEN	QUANTITY TAKEN	QUANTITY USED
Nehu	01			boxes†	boxes†
Iao	02			boxes†	boxes†
Opelu	20			fish	fish
Sardines	07				pounds

* Value represents the amount of money received by the fisherman for total pounds of fish sold. Do not record price per pound.

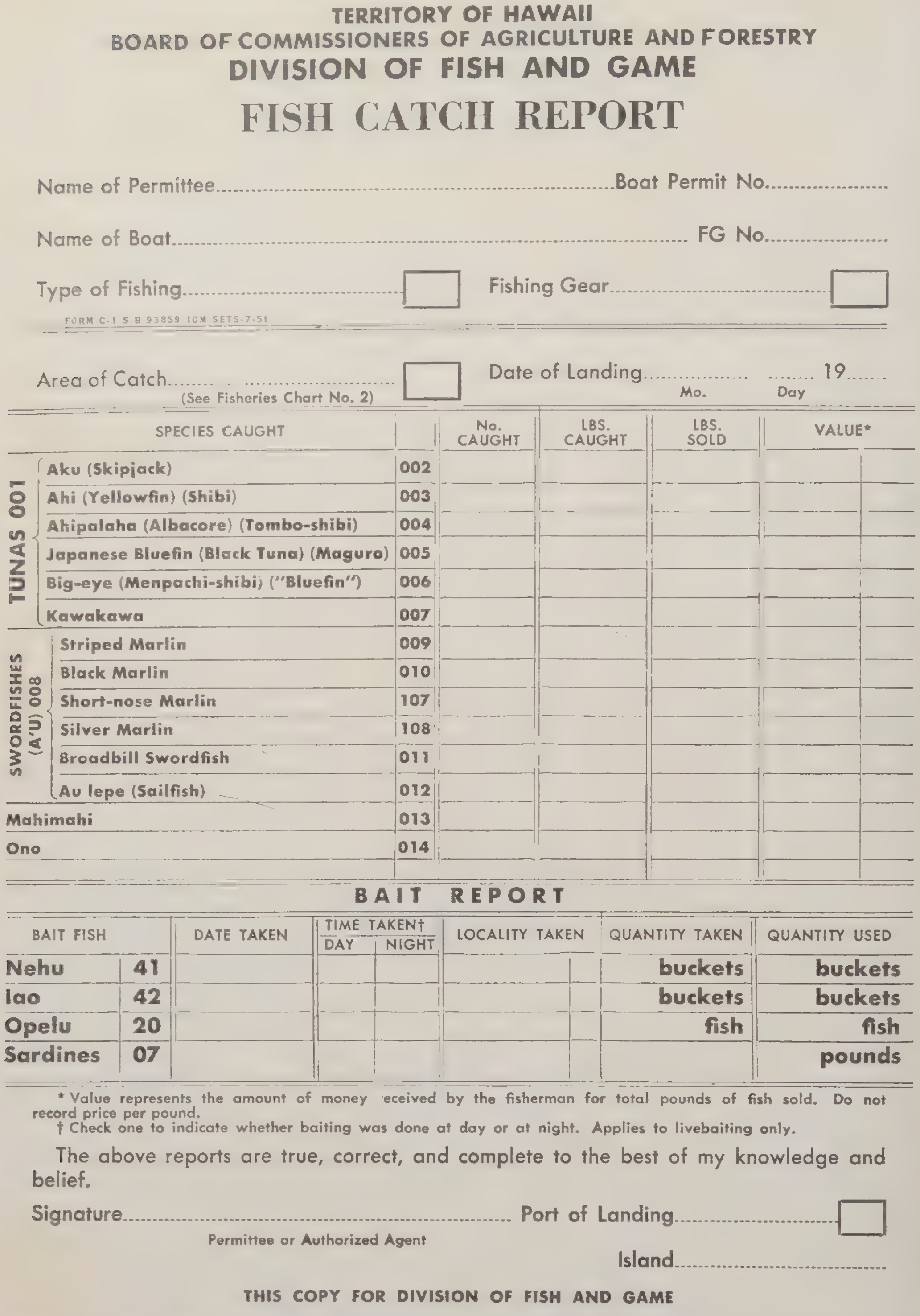
† One box of livebait is approximately equivalent to 6 buckets of livebait.

The above reports are true, correct, and complete to the best of my knowledge and belief.

Signature.. Port of Landing........................ ☐
Licensee or Authorized Agent
Island........................

THIS COPY FOR DIVISION OF FISH AND GAME

DIX FIGURE 3.—Fish-catch report form; introduced in July 1947 as standard form for reporting live-bait (skipjack) and flagline (longline) fishing.



TERRITORY OF HAWAII
BOARD OF COMMISSIONERS OF AGRICULTURE AND FORESTRY
DIVISION OF FISH AND GAME

FISH CATCH REPORT

Name of Permittee.................................... Boat Permit No....................

Name of Boat.................................... FG No....................

Type of Fishing.................................... ☐ Fishing Gear.................................... ☐

FORM C-1 S-B 93859 1CM SETS-7-51

Area of Catch.................................... ☐ Date of Landing.................. .... 19......
(See Fisheries Chart No. 2) Mo. Day

	SPECIES CAUGHT		No. CAUGHT	LBS. CAUGHT	LBS. SOLD	VALUE*
TUNAS 001	Aku (Skipjack)	002				
	Ahi (Yellowfin) (Shibi)	003				
	Ahipalaha (Albacore) (Tombo-shibi)	004				
	Japanese Bluefin (Black Tuna) (Maguro)	005				
	Big-eye (Menpachi-shibi) ("Bluefin")	006				
	Kawakawa	007				
SWORDFISHES (A'U) 008	Striped Marlin	009				
	Black Marlin	010				
	Short-nose Marlin	107				
	Silver Marlin	108				
	Broadbill Swordfish	011				
	Au lepe (Sailfish)	012				
Mahimahi		013				
Ono		014				

BAIT REPORT

BAIT FISH		DATE TAKEN	TIME TAKEN†		LOCALITY TAKEN	QUANTITY TAKEN	QUANTITY USED
			DAY	NIGHT			
Nehu	41					buckets	buckets
Iao	42					buckets	buckets
Opelu	20					fish	fish
Sardines	07						pounds

* Value represents the amount of money received by the fisherman for total pounds of fish sold. Do not record price per pound.

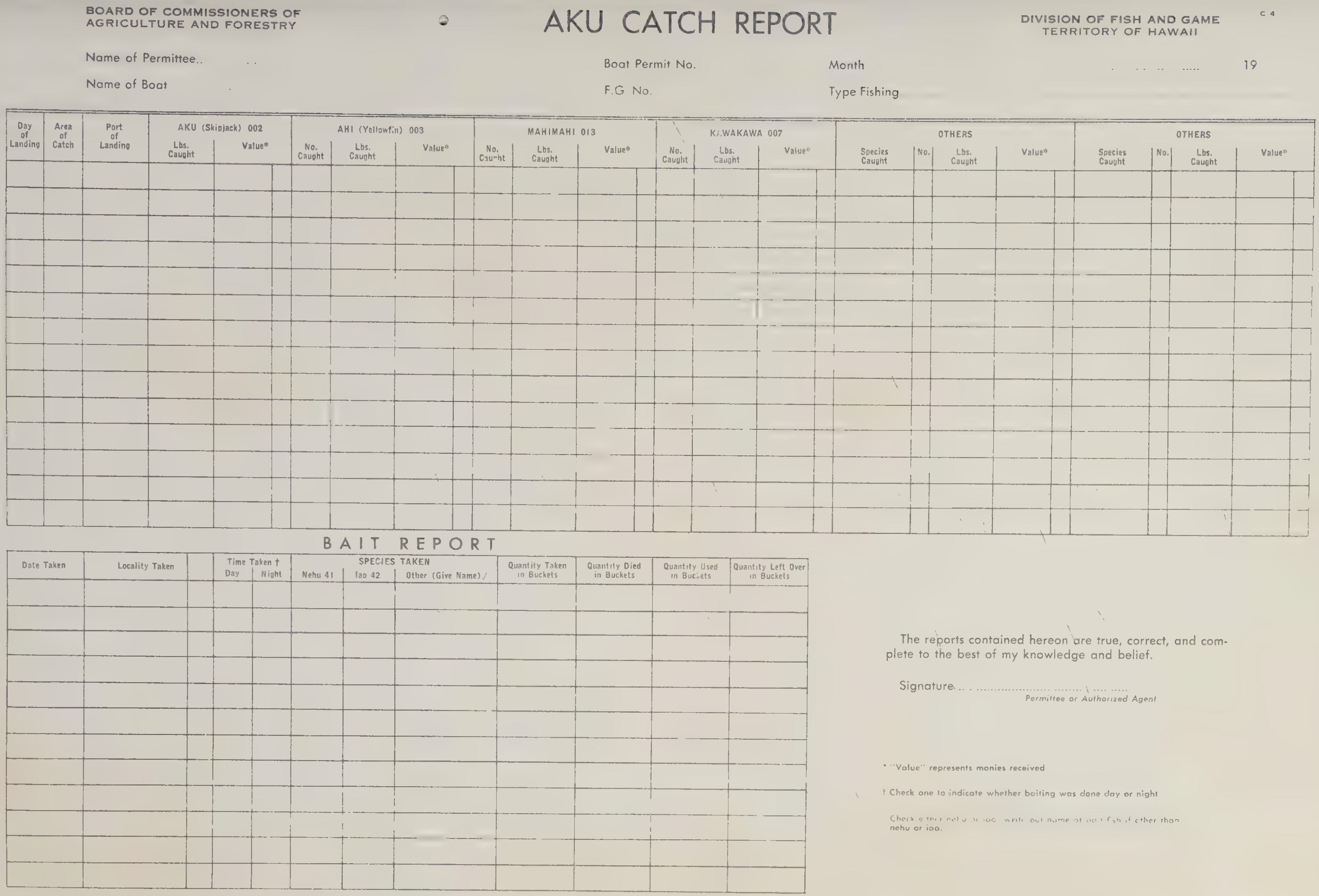
† Check one to indicate whether baiting was done at day or at night. Applies to livebaiting only.

The above reports are true, correct, and complete to the best of my knowledge and belief.

Signature.................................... Port of Landing.................... ☐
Permittee or Authorized Agent
Island....................................

THIS COPY FOR DIVISION OF FISH AND GAME

APPENDIX FIGURE 4.—Fish-catch report form; introduced in July 1950 as standard form for reporting live-bait (skipjac and flagline (longline) fishing.



BOARD OF COMMISSIONERS OF
AGRICULTURE AND FORESTRY

AKU CATCH REPORT

DIVISION OF FISH AND GAME
TERRITORY OF HAWAII

C 4

Name of Permittee..

Name of Boat

Boat Permit No.

F.G No.

Month 19

Type Fishing

Day of Landing	Area of Catch	Port of Landing	AKU (Skipjack) 002			AHI (Yellowfin) 003				MAHIMAHI 013				KAWAKAWA 007				OTHERS					OTHERS				
			Lbs. Caught	Value*		No. Caught	Lbs. Caught	Value*		No. Caught	Lbs. Caught	Value*		No. Caught	Lbs. Caught	Value*		Species Caught	No.	Lbs. Caught	Value*		Species Caught	No.	Lbs. Caught	Value*	

BAIT REPORT

Date Taken	Locality Taken		Time Taken †		SPECIES TAKEN			Quantity Taken in Buckets	Quantity Died in Buckets	Quantity Used in Buckets	Quantity Left Over in Buckets
			Day	Night	Nehu 41	Iao 42	Other (Give Name) /				

The reports contained hereon are true, correct, and complete to the best of my knowledge and belief.

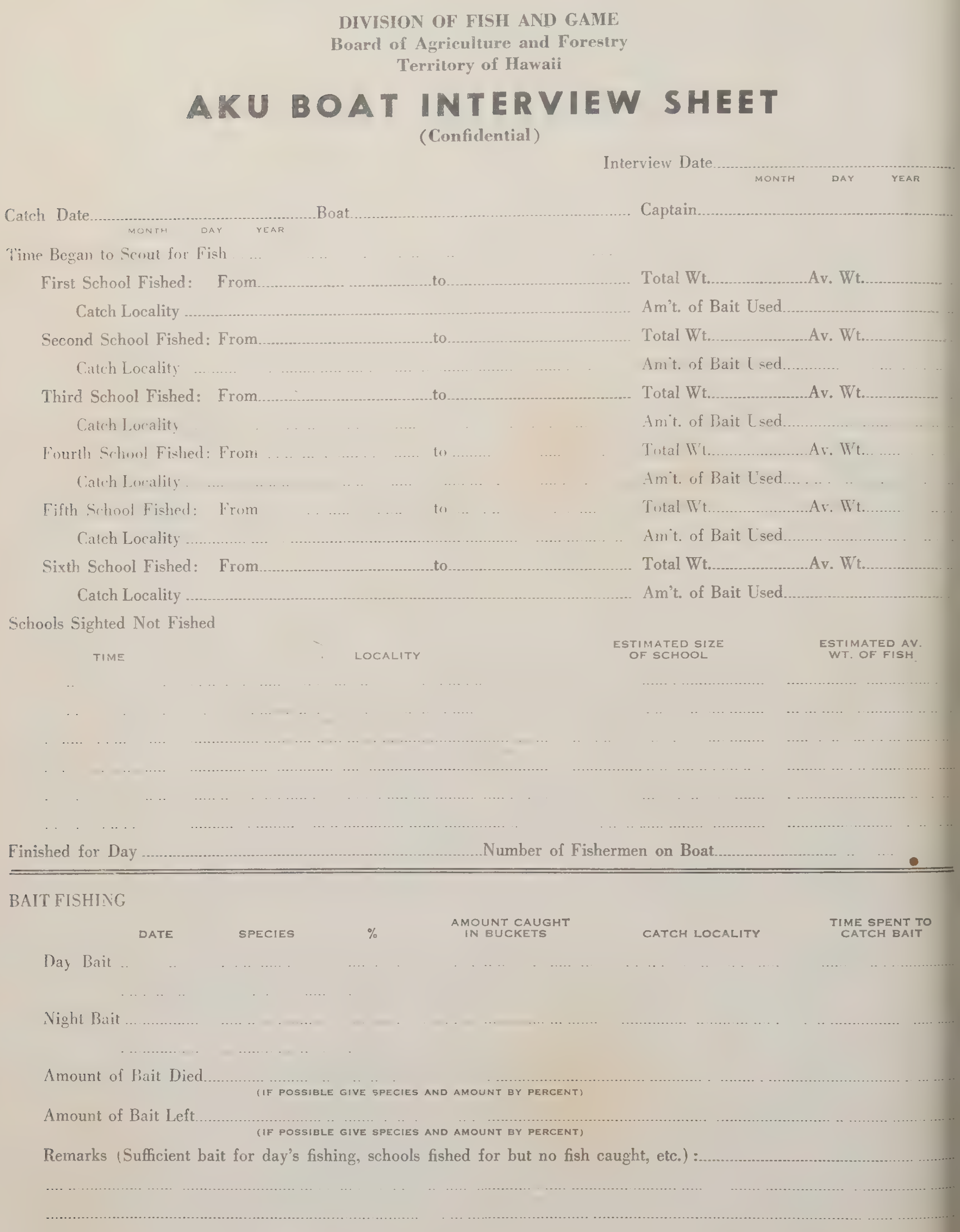
Signature.....................................
Permittee or Authorized Agent

* "Value" represents monies received

† Check one to indicate whether baiting was done day or night

Check either nehu or iao; write out name of bait fish if other than nehu or iao.

Appendix Figure 5. Presently used fish-catch report form; introduced in July 1954 as standard form for reporting live-bait (skipjack) fishing only.



DIVISION OF FISH AND GAME
Board of Agriculture and Forestry
Territory of Hawaii

AKU BOAT INTERVIEW SHEET

(Confidential)

Interview Date .... MONTH DAY YEAR

Catch Date .... MONTH DAY YEAR Boat .... Captain ....

Time Began to Scout for Fish ....

First School Fished: From .... to .... Total Wt. .... Av. Wt. ....
Catch Locality .... Am't. of Bait Used ....
Second School Fished: From .... to .... Total Wt. .... Av. Wt. ....
Catch Locality .... Am't. of Bait Used ....
Third School Fished: From .... to .... Total Wt. .... Av. Wt. ....
Catch Locality .... Am't. of Bait Used ....
Fourth School Fished: From .... to .... Total Wt. .... Av. Wt. ....
Catch Locality .... Am't. of Bait Used ....
Fifth School Fished: From .... to .... Total Wt. .... Av. Wt. ....
Catch Locality .... Am't. of Bait Used ....
Sixth School Fished: From .... to .... Total Wt. .... Av. Wt. ....
Catch Locality .... Am't. of Bait Used ....

Schools Sighted Not Fished

TIME	LOCALITY	ESTIMATED SIZE OF SCHOOL	ESTIMATED AV. WT. OF FISH

Finished for Day .... Number of Fishermen on Boat ....

BAIT FISHING

	DATE	SPECIES	%	AMOUNT CAUGHT IN BUCKETS	CATCH LOCALITY	TIME SPENT TO CATCH BAIT
Day Bait						
Night Bait						

Amount of Bait Died ....
(IF POSSIBLE GIVE SPECIES AND AMOUNT BY PERCENT)

Amount of Bait Left ....
(IF POSSIBLE GIVE SPECIES AND AMOUNT BY PERCENT)

Remarks (Sufficient bait for day's fishing, schools fished for but no fish caught, etc.): ....

....

....

CONFIDENTIAL

Appendix Figure 6.—Skipjack interview record form.

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AN ALL-PLASTIC DART-TYPE FISH TAG[1]

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Pacific Oceanic Fishery Investigations
Honolulu, T. H.

INTRODUCTION

The Pacific Oceanic Fishery Investigations (POFI), of the U. S. Fish and Wildlife Service, has been studying the skipjack (*Katsuwonus pelamis*) in Hawaiian waters as part of its program to assist the fisheries of the Pacific area. Two aspects of the biology of the skipjack on which there is presently little information are its migrations and growth. Tagging offers a direct means of obtaining information on these problems.

Employing the principle of the harpoon and utilizing plastic materials, a new fish tag has been developed which appears quite promising. The present model, patterned to some extent after the Woods Hole dart tag (through personal correspondence), has been designated the POFI D-2 tag.

Recoveries have been markedly higher than those from tags used in earlier large scale tuna tagging programs. For instance Godsil (1938) tagged 4,000 yellowfin tuna (*Neothunnus macropterus*) and skipjack with opercular disk tags and obtained no recoveries. The first successful tuna tag was developed by the California Department of Fish and Game (Wilson, 1953). This tag, in the form of a loop of plastic tied through the flesh immediately posterior to the base of the second dorsal fin, gave worthwhile returns on yellowfin tuna and albacore, but returns were low on skipjack. Our own experience is illustrative. Between 1954 and 1956, 1,961 skipjack, tagged in Hawaiian waters with the California tag, yielded 12 returns, including three from the stomachs of predators. This rate of predation may be attributed to the length of time required to attach the type G tag. As a result of its struggles during this period the skipjack is in a weakened condition when returned to the water. In this weakened condition skipjack tagged with the type G tag are more susceptible to predation than are skipjack tagged by a more rapid method. In contrast, 747 of 8,161 skipjack, that were tagged with dart tags in 1957, have been recovered, none in the stomachs of predators. Recoveries are still being made, and to date, the longest time at liberty has been 260 days. Recoveries from individual groups of 3,224 and 2,291 skipjack, tagged and released in 1957, equal 11 and 13 percent respectively.

The probable reasons for the success of the new tag are: (1) its application involves minimum handling of the fish; (2) it remains firmly anchored in the fish; (3) it is small and offers little resistance to the flow of water; and (4) it does not interfere with the fish's normal activity. An additional advantage is that the speed of application permits operators to release a maximum number of tags during the course of tuna live-bait fishing.

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[1] Submitted for publication May, 1958.

With respect to other fishes, the Wisconsin Conservation Department (personal communication) has conducted pond tests on lake sturgeon (*Acipenser fulvescens*) and found the tag better than other types used. They also obtained preliminary results suggesting the tag could be used on walleye (*Stizostedion vitreum*) and lake trout (*Cristivomer namaycush*).

CONSTRUCTION

Tag

The POFI D-2 tag (Figure 1) has two parts, a head with a barb and a streamer. The head is a Lucite rod, thirteen-sixteenths of an inch in length, and the streamer is a plastic tube five inches in length. The head is passed through a 45-degree cut made one-eighth inch from one end of the streamer, and these two parts are fastened together with a waterproof glue. A legend and serial number are printed on or contained within the streamer. The component parts and labor involved in fabrication of 1,000 tags is estimated at $95, while the cost of producing 100 needles approximates $57, but these latter are reusable and losses are minimal (Table 1).

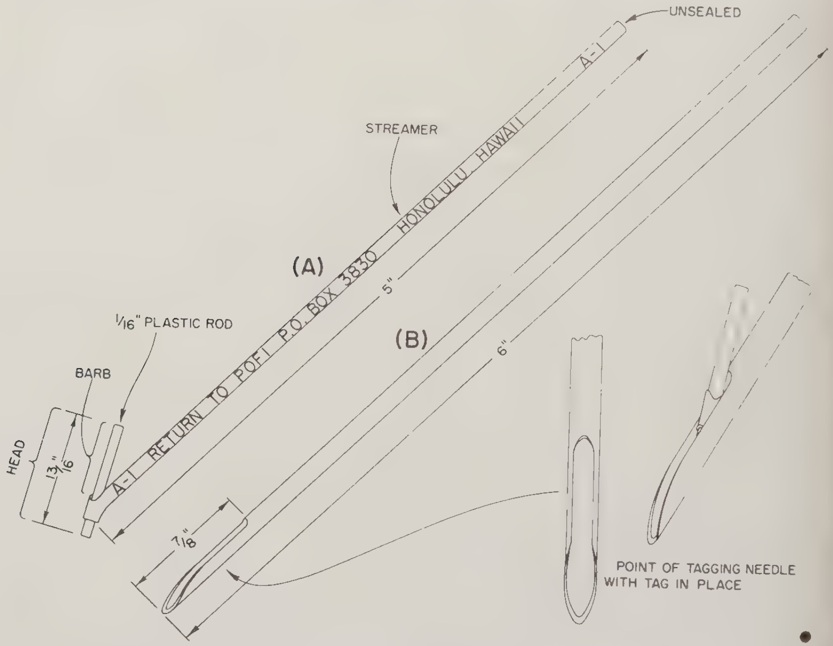

FIGURE 1. Diagrams of: (A) POFI D-2 tag and (B) tagging needle.

TABLE 1
Components and Cost of POFI D-2 Tag and Needle

Part	Description	Manufacturer or other source	Cost
Tag			
Head	Lucite rod (1/16 in. dia.)	Local plastics supplier	$5.40/1,000 tags
Streamer	Resinite EP-2 AWG size 13	The Borden Company Chemical Division P.O. Box 1589 Santa Barbara, Cal.	$5.85/1,000 tags
Waterproof glue	Seal-All	Allen Products Corp. 20450 Sherwood Ave. Detroit 34, Mich. (obtained from local hardware supply)	$0.34/¾-oz. tube
Legend	Machine printed, using vinyl plastic ink	Printing by: Hugh C. McCoy 16400 Third Ave., SW. Seattle, Wash.	$25.00 + $0.225 (ink)/1,000 tags
Ink	Black vinyl plastic (No. 104N5A4)	California Ink Co. 546 Sansome St. San Francisco, Cal.	$1.35/4-oz. bottle
Labor	Serial number and assembly	Mr. James Suyenaga 1172 Puu Poni St. Pearl City, T. H.	$55.00/1,000 tags
Total cost/1,000 tags			$95
Needle			
Stock	No. 3 tempered stainless steel 5/32 in. OD × .016 in. wall	Tubesales, Inc. 2211 Tubeway Los Angeles 22, Cal.	$54.00/100 ft. (= 200 needles)
Labor	Cutting groove and sharpening point	Precision Industries 754 S. Queen St. Honolulu, T. H.	$30.00/100 needles
Total cost/100 needles			$57

Tag Modifications

The head on the present tag is blunt at both ends, whereas the earlier models had a sharpened barb to aid in firmly anchoring the tag. Sharpening the barb was found to be unnecessary.

The original streamer consisted of a clear plastic jacket, to which the head was attached, and a red or blue tubular plastic insert which bore the legend. A red, printed paper slip was later substituted for the plastic insert, and this gave a more readable legend. To protect the paper or plastic insert, the end of the outer jacket was plugged with a short piece of Lucite rod dipped in glue. The most recent modification of the streamer involves printing the legend and serial number, one at the base and another at the end of the streamer, directly on a red opaque tube, thus eliminating the insert and the plug. The red is preferred to the blue because the legend is more legible and the color is more obvious to the human eye.

Recovered tags have shown some fading of color and legend on the streamers and streamer inserts. This appears to have been caused by sunlight, because on many of the tags only the upper side of the protruding portion of the streamer is faded. The under side and the portion of the streamer inside the fish retained the color and legend. Efforts are being made to find an ink and a plastic that are less affected by sunlight.

Tagging Needle

The tag is inserted with a stainless steel needle (Figure 1B) similar to that used for California type G tags. The point is cut as shown in the figure, so the tag head will be held securely. Without this feature the tip slips out of the groove, the head turns across the axis of the needle, and the streamer is cut off when the needle is inserted into the fish. The needle should be of sufficient length so that the end of the streamer does not protrude.

TAGGING PROCEDURE

Before fishing begins, a number of needles are loaded with tags and bound in bundles of 10. On most POFI trips, 400-500 needles are so prepared. Each bundle is labeled with a slip of waterproof paper bearing the serial numbers of the tags. Since individual measurements of fish are not taken it is not necessary to identify individual tag numbers at the time of tagging. Instead the labels and the unused tags from a bundle of 10 are retained and checked after each fishing period or day to determine what numbers were released. A tagger can carry as many as 100 tags in the pockets of a canvas apron.

The D-2 tags have been employed principally in tagging skipjack caught by pole-and-line fishing. Tags of five-inch length have been used satisfactorily on fish ranging from 2 to 25 pounds. In the fishing operation, as commonly practiced by Hawaiian fishermen, skipjack are hooked, swung up, caught under the left arm, and unhooked. The tagger stands one to two feet behind the fishermen; ordinarily there is one tagger to two fishermen. After the skipjack is caught and while the hook is being removed, the tag-bearing needle is inserted usually from the right side, about one-half to one inch below the crest of the back and between the end of the second dorsal fin and the insertion of the first dorsal finlet. When the needle is removed, the barb holds the tag in place. The needle should form an angle of about 45 degrees with the body surface of the fish, and should be inserted with the barb next to the fish and deep enough so that the head of the tag crosses the median sagittal plane. The barb will then lodge against a neural spine and firmly anchor the tag in the fish. If the tag is inserted with the barb next to (Figure 2A), rather than away from (Figure 2B) the side of the fish, the tag will also be firmly anchored, even though the head does not cross the sagittal plane. The exact placement does not seem important as long as a major blood vessel is not injured. It is important that the end of the streamer does not reach the caudal fin, or the fin will be frayed by swimming movements of the fish. Small fish should be tagged anterior to the second dorsal fin in order to prevent this injury of the caudal fin.

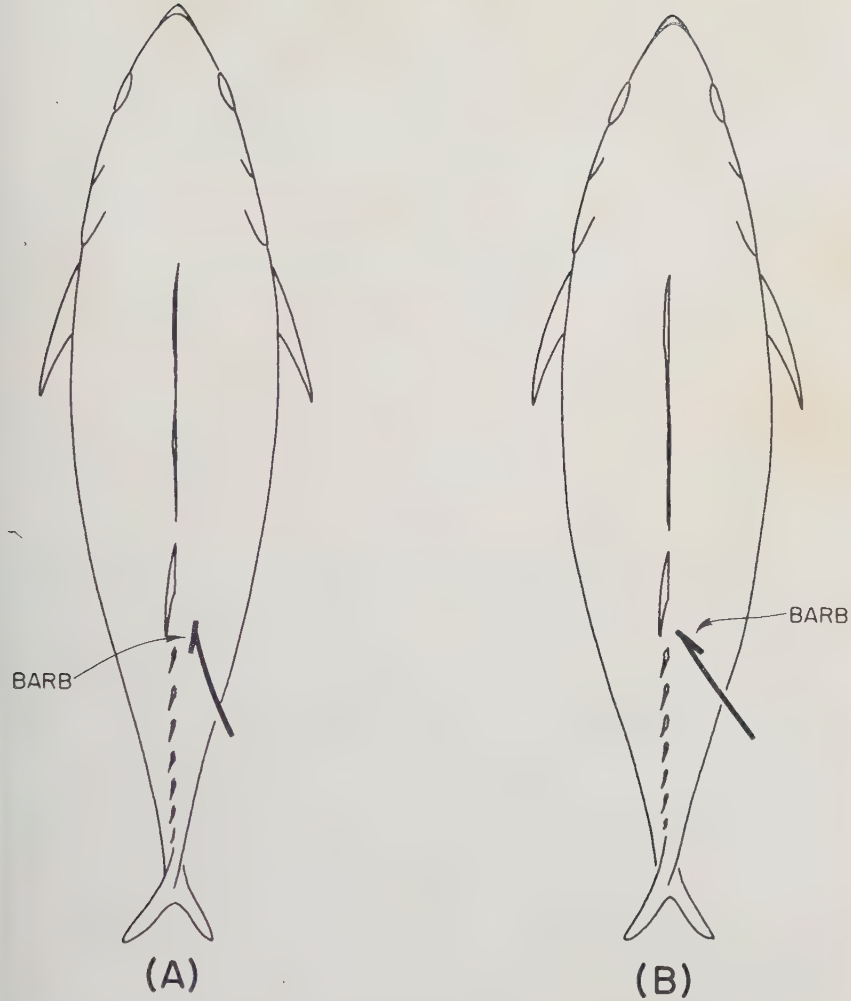

FIGURE 2. Diagrams showing dorsal view of tagged fish with barb inserted (A) next to and (B) away from side of fish.

Individual skipjack may be hooked, tagged, and returned to the water in as little as four seconds. Measurements of skipjack cannot be taken in this short time; instead, the size of tagged fish may be estimated from measurements of untagged fish caught from the same school. This estimate is considered to be reliable, because it has been shown that skipjack school by size (Brock, 1954).

EFFECT OF TAGGING ON FISH

Underwater observations of tagged skipjack indicate that they are not greatly affected by the tagging procedure nor by the presence of the tag. Tagged fish were observed to sound, then return to the portion of the school around the vessel. There have been seven instances in which tagged skipjack were recovered within minutes of being released. During the fall of 1957 one skipjack was tagged twice and released twice. The fish was initially tagged and released on November 20th. Three days later it was recovered by POFI fishermen and a second tag was inadvertently placed on it before it was again released. Fourteen days later this twice tagged skipjack was recovered by a commercial fisherman.

The tagging wound heals rapidly with no infection. Scar tissue is present within 10 days of tagging and well developed within a month. The scar tissue does not usually fuse to the tag but forms a tight, glove-like pocket around the head and streamer. The external wound is small, scarcely larger than the streamer (Figure 3).

SUMMARY

An all-plastic, dart-type fish tag was used with considerable success on skipjack in Hawaiian waters during 1957. Recoveries from individual groups of 3,224 and 2,291 fish equalled 11 and 13 percent respectively. In addition to the high percentage of recovery the tag has

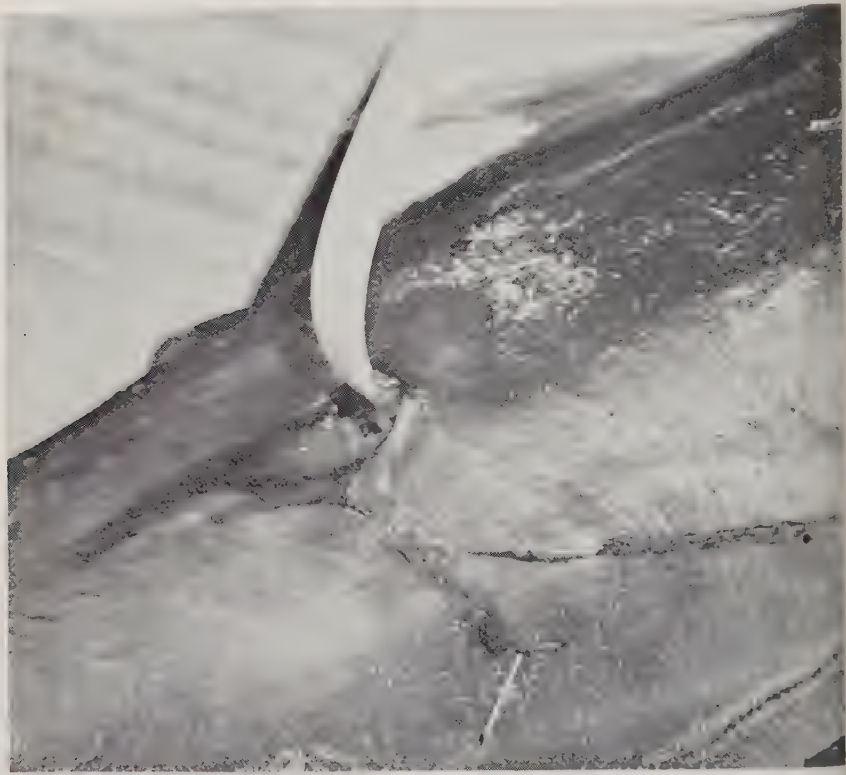

FIGURE 3. Skipjack with D-2 tag recovered 30 days after release. Tag pulled forward to show small wound and growth of new skin around opening. *Photograph by K. D. Waldron, June, 1957.*

other desirable characteristics such as: (1) small size; (2) simplicity and rapidity of application; (3) low resistance to water flow; (4) secureness when attached properly; (5) negligible effect on the natural movements of the fish; and (6) one uniform size may be used on fish weighing between 2 and 25 pounds. Because of these advantages the dart tag should be suitable for use on a great variety of fishes.

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